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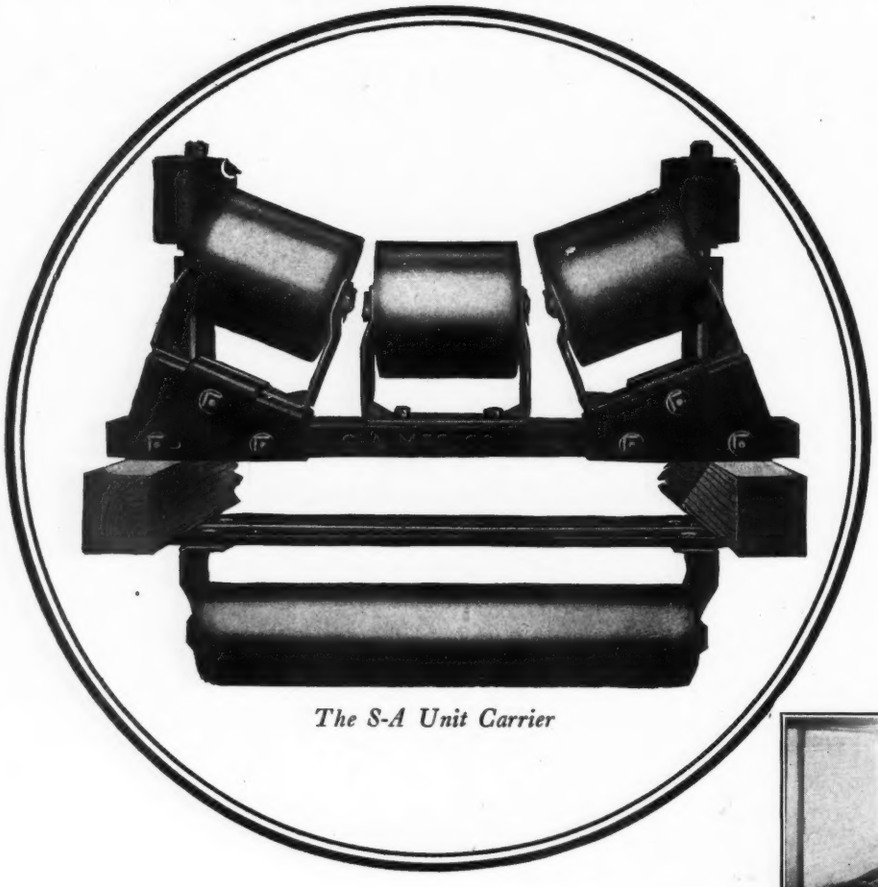
May 28, 1921

The Development of the Rod Mill

By Edward H. Robie

The Engels Copper Mine and Mill

By George J. Young



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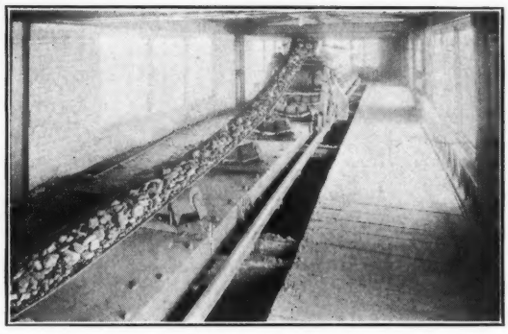

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Franklin K. Lane

He left no will and no estate.—*New York Tribune* news item.

WE PROBABLY should not have been so quickened to notice editorially the death of the former Secretary of the Interior had it not been for the laconic sentence quoted above, which is the end of probably the last news item Franklin K. Lane will ever get. Publicity rushes back for news of the living. Yet we cannot let this last word of his newspaper epitaph go by without comment. As Secretary of the Interior, Lane was ipso facto Secretary of Mines, and many of us have come in personal contact with him. We know that he left an estate—a legacy to the American people beyond the ability of accountants to evaluate. He left the memory and the inspiration of a high soul, a clean life, of a great ideal of public service, of a career devoted to humanity, which great things so occupied him that he never found time for the accumulation of cash. We know that he left a will—a will to live intrepidly and without currying favor, and to die serenely, awaiting the orders of a Destiny which he frankly recognized was beyond his comprehension. "I accept" was the creed he dictated on his deathbed.

To those who place, as the great objective, business, commerce, the accumulation of lands and bonds—to the greatest commercial country in the world—such an estate, such a legacy as he bequeathed to the world, is priceless. It is not an isolated case, and reveals the deep-set foundation of the nation, on which the busy superstructure of bartering, toil and hubbub, and the great constructive work of industry, is reared.

During the war, a member of the War Cabinet whose entire record was that of a money-getter once remarked to Secretary Lane in scorn, "Queer that these doctors, experts, and scientists who are so busy around here don't seem to be able to make any money." "Did it ever occur to you," rejoined Secretary Lane, with finer scorn, "that there were people with other aims and ambitions than to make money?"

It is said of estates that a man cannot take them with him when he passes into the Shadows which Franklin K. Lane entered at Rochester. But the great estate he left was not of that kind; he takes it with him wherever he goes—and he leaves it all to the country.

New War Minerals Relief Legislation

A BILL (the Shortridge Bill) is now before Congress to amend the existing War Minerals Relief Act. It provides, in effect, that the existing provision as to war production (that the metals in the production of which losses were incurred must have been produced "on the request or demand of the Government") shall be so liberalized as to permit recoveries for metals produced "in response to any personal, written, or published request, demand, solicitation, or appeal from any of the Government agencies in said act." The reason for this attempt to amend the original measure is the interpretation of the cited clause in the original act, by the executive branch of the Government, to cover only direct request or demand or "stimulation," which must be proved in each individual case, and to exclude newspaper or magazine appeals, or those requests or appeals that were made through circulars. On this decision the administration of the act has gone steadily on, and the work of the War Minerals Relief Commission of the Department of the Interior, and of the organization of engineers and auditors of the Bureau of Mines, under the Chief Engineer, is now practically completed. We understand that Chairman Shafroth is leaving for a well-earned vacation in Europe, that Mr. Moore has tendered his resignation, and that only Mr. Pomeroy will be left temporarily to clean up the odds and ends.

The new legislation, if it passes, will admit *all claims hitherto excluded* on the basis of such claimants having been unable to show any specific and reasonably direct "request or demand" by the Government. Various circulars and newspaper and magazine articles, during the period of war need, reported the desire on the part of the Government for an increased activity in the production of the necessary war minerals. Most inclusive, perhaps, was a general appeal printed as an advertisement in the *Saturday Evening Post* and other publications, entitled "Wanted—Men To Discover America," and signed by the late Secretary Lane.

In a way, the proposed legislation remedies artificial and unjust distinctions. No specific "request or demand" which amounted to a verbal order or contract, for the production of any war mineral, was ever made on anybody; the obligation of the Government, if it existed, was not legal but moral. And the moral obligation rested on the fact that the Government did urge, in general, increased domestic production of high-grade manganese, chromite, and pyrite east of the Mississippi. If the Government is to pay at all for losses in mining operations resulting from this urge, the only fair way is to pay in all cases, and not to make quibbling distinctions, as was done by Congress in the original act, as to who was advised direct by an officer of the Government as to its needs (and so came within the interpretation of the act) and who got the message only indirectly or read it or heard about it (and so fell into the group whose claims were disallowed under the act).

The reader will note the restriction above to high-grade manganese, chromite, and pyrite east of the Mississippi. Another evidence of the light-hearted and careless handling of legislation by Congress and its interpretation by the Executive Branch is that under the act producers also of tungsten have recovered substantial damages, as also have producers of low-grade

(spiegel-grade) manganese ores. No real Government urge, request, demand, or stimulation was ever made for these minerals; and it would have been quite as fair to the miner and the taxpayer to have included the whole list of minerals, from antimony to zircon, as was indeed attempted by the promoters and prospective beneficiaries of this legislation.

Now, if all losses incurred in the war-time production of chromite, manganese, pyrite, and tungsten are to be paid (as they will be under the Shortridge Act), we shall indeed have lived to see the halcyon days of mining—a blessed war period where every mining enterprise which has not turned out profitably has its losses made good by the Government. Would that we could induce the Government to continue indefinitely the same wise and liberal policy; it would induce many, who are now reluctant, from having been once singed, to return to the game.

But we must criticise the blundering and discriminatory legislation of Congress: if it holds its first act incomplete and hasty (as it has), why has it waited till it had been diligently and faithfully carried out before throwing the gates wide open? This late change of heart will admit three and a half million dollars' worth of claims disallowed for failure to show "request or demand" under the act. Moreover, under the administration of the act, damages for each claim on which award has been made have been figured by the auditors and engineers, for a certain "stimulation date," at which claimant was able to show "request or demand," which differed in each particular case. If the new Shortridge Bill becomes a law, the awards on these claims should in equity also be reconsidered, as the published request or appeal will probably be found to really date back to the entrance of the United States into the war. Can such awards be reconsidered? Under existing Treasury rulings that an award once made closes the claim, it is altogether probable that they cannot be reopened. Here, then, we have new inequities likely to require separate Congressional bills of relief in each case.

Again, 100 claims were ruled out because they were received after midnight, June 2, in accordance with the original act. Is it not inequitable, if all losses are to be paid, to exclude those who heard this news a little late, or who were so unfortunate as to be far from the post office?

Our readers will rightly conclude that the whole war minerals business has been a muddle. In the war activities of the executive branch of the Government, it is not hard for the student to put his finger on the beginning of these claims—the activity of the War Industries Board and of the Ship Control Committee of the Shipping Board in succeeding in bringing in under the "ballast and backhaul" argument large and entirely unnecessary shipments of chromite from New Caledonia, and so breaking the announced importation limit set by the Committee on Mineral Imports of the War Trade and Shipping Board, over the protests of the latter. Thus there was created a valid argument (and the only valid argument) on the part of the producer for a claim against the Government for his losses. The consideration of the various executive and legislative blunders made by the Government in the matter of war minerals speaks eloquently for a stronger Government organization to administer this most important branch of our industry. It is plainly evident that we need a Department of Mines.

Needed—A Congressional Editor

WHEN, at the last Presidential election, we were called upon to choose as Chief Executive between two small-town editors from Ohio, our ideas as to the dignity of the editorial profession were immeasurably advanced. We recalled that Theodore Roosevelt became contributing editor on the *Outlook* on retiring from the Presidency, as the only position of dignity compatible with his earlier occupation; and that ex-President Taft is before the public at present largely as a newspaper writer. Also, when George Harvey was sent as Ambassador to England to sit in with Lloyd George and Briand, and settle the world affairs, we realized that public sentiment demanded editors as those best trained to tell the people what to do about everything, including much in which said editors may not be at all versed.

We note the steady call, for such national positions where an assumption of wisdom and a firm manner of laying down principles is needed, on professions trained accordingly. First, and still, it was the lawyers, that class to whom, in their own judgment, and by their own confession, all human knowledge and wisdom has been vouchsafed. Next it was the college professor, to whom the same remarks apply. Finally, thank Heaven, it is the editor, to whom also the same remarks apply. And we (speaking editorially) begin to think that after all a deeply concerned Destiny has led us (speaking editorially) into the path leading to the high places we have always thought (speaking editorially to ourselves) we should grace.

And this moves us, seriously, to a practical suggestion. We could point out a lot of ways to improve the Government; but one of the things it needs badly is an official Congressional editor. The acts of Congress are frequently—if not typically—passed without anyone (including in this any Representative or Senator) really knowing what they mean. They are the result in most cases of compromise, suggestion, concession, and striking out; everybody has a crack at them, and finally they are rushed through by those who have them in charge, to escape further manhandling.

Let us be specific, and take the War Minerals Relief Bill, which was so patched up and cut into that it was as if Joseph's coat had been through a machine-gun attack. No one could say what it really provided, or why. So it had to be interpreted; and this by the solicitor of the Interior Department and by the Attorney General. They were skillful and competent enough, and put more clear intelligence into it than any of the Congressmen who had worked on it had any idea of; when it was thus elucidated to them they had the first clear idea of what they had said. To some of them it was what they had intended to say: to others it was not at all what they had had in mind. The majority never knew exactly what the whole thing was about and didn't particularly care whether the language said this or that. Was it not the best they could do under the circumstances?

But not only the Government attorneys become needlessly vexed and overworked by this carelessness of phrasing, but a host of private attorneys as well. These are bound to question the Government attorneys as to their interpretation of what the act failed to state, to argue and have hearings thereon, to try to throw it into the courts, so that the meaning may be argued on some more. What Congress intended—the deep meaning of the phrases—becomes a Rosetta stone or a Delphic oracle, embodying all wisdom, but hard to get at.

In an editorial last week, we quoted from a bill recently introduced to exempt from taxation the net income of corporations engaged "in the mining of gold, or in the mining, milling or reduction of silver." Should this become a law, we can foresee the thousands of arguments as to what under the circumstances was included in the "mining of gold." In corporations mining both gold and silver, as at Tonopah and many other camps, the accountants as well as the attorneys would find steady occupation in figuring out the income derived from the mining of gold, but not the milling or reduction, in the right proportion to the mining, milling and reduction of the associated silver.

Therefore we suggest that an official editor be appointed to Congress, to scan the verbiage of all bills before they are released from Congress, and to have the authority to hold up bills until he can make clear and unequivocal sense out of them. If the Congressmen who pass the bills cannot explain clearly what they meant, he should be empowered to return such bills to them with instructions to find out, and to assist him in incorporating such new or amended language in the bills that the intent may be quite clear.

Judging from the War Minerals Relief Act alone, such an editor would be cheap in Congress at a million dollars a year. We do not say that we would not serve for less; and we hope if the idea should appeal to the public as sound (and it is very sound) that the proponent should naturally have first call on the office. The cost of living in New York is very high.

Company Reports and Company Reports

SPRING is commonly associated with the budding of the leaves, the peeping of crops through the soil, an intense desire to get out in the open, and many other physiological indications of seasonal changes; but in our editorial offices—to bring our thoughts back to more prosaic matters—spring is heralded by a flood of company reports. Most of them come from the New York headquarters of mining companies and tell of operations, successful and unsuccessful, in all parts of the earth. Naturally, an excellent opportunity is given to compare the merits of the financial information furnished stockholders—usually the public—and to observe with what care the directors and company officials choose to conceal or reveal certain operating details.

Interesting contrasts are afforded by such an inspection. Some company activities are reported *in extenso;* others confine themselves to such meagerness of data that they are practically valueless. Many reports are so clearly presented that a person unfamiliar with the complex terms frequently used in accounting can readily grasp the significance of all the financial statements; others are so beclouded by the grouping of an immense amount of related financial matter that the accounting terms employed are meaningless without other interpretation. It seems as if a fraction of the mining companies frankly exposed all their wash on the line, whether fine linen or tattered rags; others prefer not to expose their laundry to the inquisitive public gaze.

From among the many annual reports which we have recently examined, a few strike us as being models of excellence in the presentation of mine accounts; whereas many are a waste of time to read.

The report of the Bunker Hill & Sullivan Mining & Concentrating Co. deserves especial commendation as belonging to the best class. Practically every question arising in the mind of a stockholder covering the financial and physical condition of the Bunker Hill properties is answered in this report, and operating details are given with such minuteness of detail that they are a valuable guide not only to the cost of silver-lead mining in Idaho but to the economics of mining in general. Excellent maps of the surface and mine workings are included, graphically illustrating the advances made during the year. Costs, be they exploratory, stoping, pumping, or milling, or other elements of expenditure, are itemized to an unusual degree. Balance sheets and income statements are examples of financial simplicity, without sacrifice of clearness. A report of this sort must result in imposing utmost confidence in the direction of the enterprise.

The porphyry copper reports, and those of Miami Copper, Tonopah Belmont, Calumet & Hecla, and Chile, to mention a few, are excellently presented and well worth studying, giving a fund of information about the varied operations of these organizations. Frequently the generosity with which a company dispenses details of its technical processes is not the attitude carried to its finances; at least the stockholders and public are not taken into confidence to any marked extent. The Anaconda Copper Mining Co., to mention an example, furnishes but the barest financial outline of its manifold operations, though it is an exponent of a ready exchange of technical information. The New Jersey Zinc Co., in its reports, goes many steps further in conservatism.

What policy guides certain companies in withholding financial information to stockholders? Is it an underestimation of the comprehension of the stockholders, a fear of furnishing competitors with valuable data, an innate secrecy, or some other reason? We don't know. No doubt the policy adopted is often the outcome of continued conservative control. It is our impression that the tendency is distinctly toward greater freedom in financial details, and that mining companies are realizing more and more that taking the stockholders into their confidence can only breed a wholesome solidarity between them and directing officials, a desirable asset in times of depression. Perhaps the reports of the future will show considerable general improvement. At any rate, it is a pleasure to find here and there, among the many reports that come to our desk, some that are as different from their fellows as the English language from Egyptian hieroglyphics. Not only are they appreciated by us, but by the stockholders, for whose enlightenment they are intended.

Electrical Prospecting in Queensland

"ELECTRICAL ORE-FINDERS" have been used in prospecting by some operators in the recently opened silver-lead district at Indooroopilly, near Brisbane, according to our correspondent in Queensland. Ordinary methods of prospecting failed there, it seems, owing to the absence of outcrops. Much interest has been shown in the experiments, if so they may be termed. They have, however, disappointingly proved unsuccessful. Shafts sunk below the depth where the "diviners" had predicted ore would be found have failed to reveal it. Our correspondent does not describe the electrical instruments used nor the mode of employing them. The news, however, is of interest in connection with the article, by Mr. Schlumberger, on underground electrical prospecting that we have recently published.

WHAT OTHERS THINK

Self-Education

"Only a Correspondence School Engineer," applied as you applied it, in one of your recent editorials, has the effect of doing the one thing which you probably have no desire to do—providing *Engineering and Mining Journal* is read, as you intend that it shall be, by men engaged in mining and metallurgy, especially young men. It discourages many who have not had the advantage of attending a technical school, but who have hopes of overcoming the disadvantage by applying themselves to a correspondence school course. Many a man who has started out on such a course with enthusiasm and high hopes of accomplishing something for himself will decide that if the attitude assumed by the mining world is that which you have expressed there is no use; and then and there he will lose his enthusiasm and do nothing more, and the man he might have been shall never be.

There can be no question that in choosing a doctor or a lawyer, and having no references, one would look for the man who had been trained in the best schools and not one from a correspondence school. However, if a certain man had a wide reputation, the choice would be based upon it, and no inquiry made as to the source of his knowledge. In fact, except in the case of a man new to these professions, no inquiry is made as to his schooling. Judgment is based upon his reputation for accomplishment and upon his character. Many poor men escape from first class schools and many good men come from poor ones.

A man who is graduated from a mining school realizes two things: The vast amount he does not know, and that all he has acquired is a foundation upon which to build. His most important accomplishment is to read understandingly matter without which his education would be beyond his reach. His ability, reputation, and success must be built upon that part of his foundation, and to this he must add experience.

Perhaps some, but few indeed, can be expert in all branches of mining and metallurgy, no matter what their schooling may have been. When we come to a subject in which we are not expert, and in which we have to solve problems, there are but two things to do—employ an expert in that particular subject or read. Most of us have to do the latter. If one happens to have been engaged during most of the years since graduation as an executive, he will, most certainly, be rusty on many subjects. You find yourself examining a mine and working out the geology. It has to be done, you have to do it, and you have had little to do with geology for many years. What must you do? You must use your foundation and read the best books on the subject. Probably those of Weed, Emmons, Lindgren, Spurr, and others—and you apply the results of this reading to your problem.

The following month you find yourself confronted with a metallurgical problem. You are not an expert metallurgist, but you have a foundation, and you repeat the process noted above; get the best books on the subject, read them, and apply what you get to your problem.

When it comes to stratigraphy, most of us realize that no matter how much we may read, it is probable that we will make serious errors; so we call upon a paleontologist to identify our fossils. We are confronted by the necessity of making a mineralogical determination. If it is simple, we feel certain of ourselves, but for anything out of the ordinary we have to call on an individual who devotes his time to crystallography and petrography.

You must recognize that the courses given by the best of the correspondence schools are complete and thorough, so far as they can be without laboratories, and are especially well written. It would be well for many of us to carry correspondence courses in subjects which we are not applying, especially in mathematics and allied subjects.

A mine manager should encourage the young, uneducated man in his employ to acquire an education and to read and to observe. The correspondence school offers the means for education; but if in reading the technical press young engineers find discouragement, where, above all other places, they should find encouragement, the manager will find himself facing a hopeless task. His enthusiasm, interest, and efforts will cease.

There is nothing better than just criticism, and a good man appreciates it. It would seem that the able and brilliant editors of the technical press, with the opportunities afforded them for encouraging, educating, and putting enthusiasm into the young men of the mining industry, could be less critical and more helpful; as it were, surround themselves, as do many great teachers, with a following of loyal, earnest young men, who would feel free to go to them with any subject concerning their profession. E. M. GLEIM.

Terlingua, Tex.

The Birth of a Nugget

Your editorial on the "Birth of a Nugget," on p. 506 of the issue of March 19, is interesting, as indeed is the matter of the origin of nuggets in general. Apparently there is no escape from the conclusion that they are battered down and more or less water-worn particles from veins, freed largely from the matrix by weathering and stream action. But why has no one found in a vein masses that with any amount of such treatment would yield nuggets like Australia's Welcome Stranger? Is it because these exceptional pieces occur only in the upper portions of veins which have grown lean as they increase in depth? It would sometimes seem so.

It will be recalled that about twenty-five years ago Liversige, of Australia, undertook a series of experiments with a view of testing out a popular notion that the nuggets grew in the gravel by a process of chemical accretion. The evidence attained was to the contrary. Some years ago, in connection with my museum work, I started to collect a series showing the various stages by which a mass of dendritic gold might through natural agencies be reduced to nuggets. The necessary materials proved too expensive for a national institution, and I was obliged to give it up. Nevertheless, if any of your readers have any really instructive specimens in this line that they wish to donate the national collections, I shall be glad to give them a place.

Washington, D. C. GEORGE P. MERRILL,
Head Curator of Geology,
Smithsonian Institution.

The Development of the Rod Mill

Cylindrical Grinders Using Rods Instead of Balls Now Receiving Much Attention in This Country—Wide Application for Stage Grinding in Connection With Roughing Table Treatment and Flotation Indicated

BY EDWARD H. ROBIE
Metallurgical Editor, *Engineering and Mining Journal*

ALTHOUGH not a new type of machine, the rod or roller mill for grinding ores has come to be seriously considered by most American mining engineers only within the last year or so. At present it is invading the field which the ball mill has so exclusively occupied in this country for the last ten years; or possibly it would be more correct to say a part of the field, for the rod mill is neither adapted to, nor do its proponents advocate, grinding in one machine through the wide range of sizes which the ball mill accomplishes more or less efficiently.

If the rod mill has been on the market for several years and has merit, why has it not been more widely adopted? There are several reasons: Until recently it was generally believed that a slimed pulp was necessary or desirable for the flotation process; in fact, no doubt it was, with the more limited knowledge of manipulation and reagents possessed by flotation operators from five to ten years ago. The ball mill (a cylindrical or conical mill using large steel balls) had grown up with the flotation process and was found well adapted to the preparation of a pulp whose coarsest particles passed a 48- or 65-mesh Taylor screen (0.295 or 0.208 mm.) and which had the desired proportion of fine slimes. Then, too, the ball mill has another feature which made it popular. Early in the last decade American engineers became converts to the idea of simplification of ore-dressing plants. The fewest possible machines and processes was the great desideratum. A concentrator the flow sheet of which could not be comprehended at a glance was not à la mode. The Jackling concentrating plants, Utah Copper, Nevada Con., Ray Con., Butte & Superior, Chino—particularly Chino—were ridiculed as being examples of how not to do things. In this wave of simplification—or shall I say simplicity?—the ball mill fitted perfectly. Feed as large as three inches for 8-ft. mills was not only suggested as a possibility but recommended for regular practice, with the classifier overflow going to flotation. Into this scheme, the rod mill did not fit at all. It was tried in a few instances, but, as a competitor of the ball mill, was considered to have been introduced too late. It would have been a fine machine, said millmen, to grind a Chile-mill product for tables and vanners. Another reason for lack of early excitement about rod mills was the generally accepted opinion that the type of machine first introduced was mechanically weak. Also, the fact that the company manufacturing them was not financially as strong as its ball-mill competitors, and thus was not able to push them properly, must be taken into account.

With the further development of flotation and an appreciation that the ball mill might not be an efficient crusher on 3-in. feed, conditions became more agreeable for such a machine as the rod mill. In giving more attention to this mill, metallurgists have had in mind a machine to fit into a flow sheet somewhat as follows: Crushing to approximately one inch with gyratories, rolls or disk crushers; grinding to 8 or 10 mesh, followed by tabling; and regrinding table sand tailings to the necessary size for flotation. To such a flow sheet, particularly for ores giving a low ratio of concentration, the rod mill has its application, and the design of a suitable machine has been receiving no little attention.

For the benefit of those who have no clear idea as to what a rod mill may be, it may be described as similar to a tube mill but with rods of approximately the same length as the mill, instead of balls or pebbles for the crushing medium. Line contact rather than point contact, therefore, results, thereby increasing the effective grinding area per unit of steel and also reducing the tendency to crush a part of the ore to a very fine state of division. This may readily be visualized. Suppose two steel balls are considered; if brought in contact they meet at a point, and any ore particle which happens to be at this point is crushed or ground exceedingly fine, the actual fineness depending upon the force of impact and movement of the balls, and the resistance of the ore particle. As we go away from this point the spherical surfaces become farther apart and the crushing or grinding action will result in proportionately coarser particles, until we get so far away that such action will not take place, but the particles will merely be shoved aside.

With rods instead of balls, the action will be similar, except that maximum crushing and grinding will take place along a line instead of at a point. Other conditions being the same, the maximum impact will never be as great as in the case of balls, for the impact and weight, though greater, are distributed over many points instead of centering at one point. Furthermore, there will not be the tendency to crush exceedingly fine, for, if we consider the rod to be rigid, the entire crushing action along any longitudinal line is concentrated on the two coarsest particles which support the rod, thus allowing the finer particles between a free clearance. In practice, of course, the rods are elastic and not strictly parallel, but the maximum grinding action is always exerted on the coarsest particles. We would expect, therefore, a narrower range of sizes in the product, and this is actually what is produced. The rod mill, then, is adapted to stage grinding, and if it is desired to grind a coarse feed to flotation fineness, multiple units must be installed or ball mills employed. On ores which will yield a good recovery by jig or roughing table treatment, the rod mill promises to be an excellent machine to use, particularly if any tailings sufficiently low in value to discard can be obtained, for unnecessarily fine grinding of barren rock is thereby obviated.

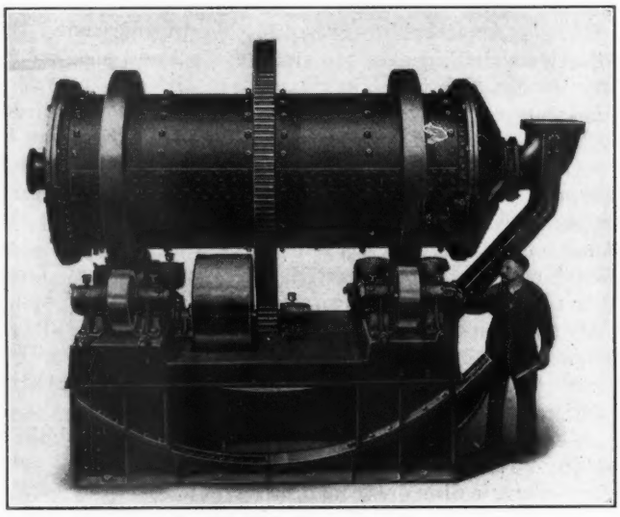
Because of the limited application which rod mills up to this time have received, not a great deal of operating data is obtainable. Some types have yet to wear out their first set of liners and others have hardly passed the experimental stage. This article will, there-

fore, be confined largely to a brief description of the various rod mills now on the market, their principal features, where they have been installed, and the kind of work which they are doing. The information given has in part necessarily been furnished by those interested in the type of mill under discussion, but I believe none is misleading. In fact, without the assistance of E. C. Johnson, F. E. Marcy, O. H. Johnson, C. G. Willard, David Cole, J. E. Knapp, and R. C. Greenfield an article of this scope would not have been possible.

E. C. Johnson's "Marathon Mill" the Pioneer

The idea of using a rod or a few bars extending from end to end on a drum-type mill is old—something over fifty years. The original patentee of a practical machine of this type I believe was a German by the name of Zarinko. Ernest C. Johnson, who developed the Marathon mill, patented certain details on Feb. 6, 1912, and the credit for securing practical results with the rod mill is due to him.

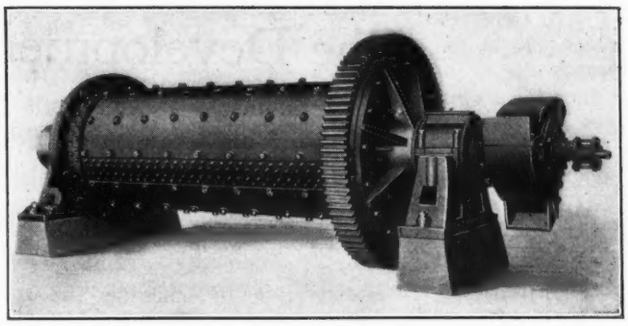
The Marathon mill has been on the market about



THE MARATHON MILL—ORIGINAL DESIGN

eight years. The Phelps Dodge Corporation ran extensive tests on these machines in 1914 and 1915, which proved their worth as granulators with a low power consumption. They were installed in several of the Phelps Dodge concentrators, notably at Morenci, Tyrone, and Globe, and also in the southeastern Missouri lead district, and elsewhere. An excellent description of the mill and the early experiments with it at Morenci is given in the paper by F. C. Blickensderfer in Vol. LV of the *Trans.* A. I. M. E., p. 678 *et seq.* In 1917, A. E. Watt prepared a paper (*Trans.* A. I. M. E., Vol. LVII, p. 357 *et seq.*) describing the use of the Marathon mill on Missouri lead ores. These papers describe the general features and work of the mill completely, and repetition is not desirable here.

The two illustrations show the original design of mill, as well as a later type in which the weight of the mill is carried on trunnion bearings instead of on rollers. The mechanically unsatisfactory features of the original have been gradually eliminated in the later types, and the mills which have been in use at Morenci and Globe in the last two or three years have operated as smoothly as one could wish. Three distinctive types are now made, the full roller wheel, with the grinding cylinder rotating on four roller wheels; the full trunnion type, as shown in the illustration; and the half-trunnion half-roller-wheel type, in which the feed end is supported by a trunnion bearing, and the discharge end on rollers.

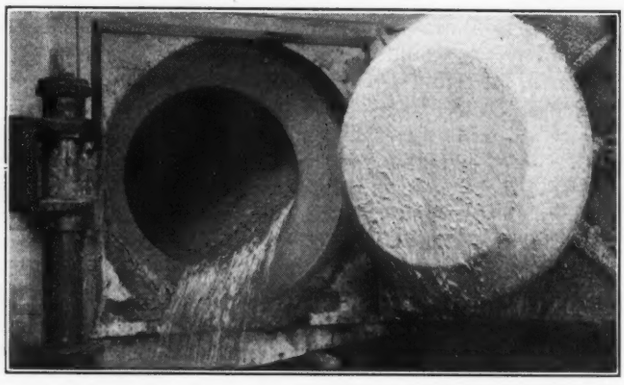


THE NEW TRUNNION-SUPPORTED TYPE OF MARATHON MILL

Marcy Roller Mill Designed To Use Larger Rods and To Allow Easy Access to Interior

In March, 1916, F. E. Marcy began experiments on a rod mill of somewhat different design. He called this a roller mill, because he planned to use 3½-in. rods instead of 1- to 1½-in. By so doing he expected to secure greatly increased capacity. Other features were an easily opened head for the removal of worn rods with the minimum of inconvenience, and a large discharge opening which would give a low-line discharge and result in a minimum quantity of pulp in the mill. The lining of the mill was also to be slightly tapered toward the discharge end to retain the rods. In January, 1917, arrangements were made with the Anaconda Copper Mining Co. to install such a mill, approximately 5½ ft. in diameter and 10½ ft. long, and it was placed in Section 1 of the Anaconda concentrator, in closed circuit with a Dorr classifier, where it began grinding table middlings some time in June, 1917.

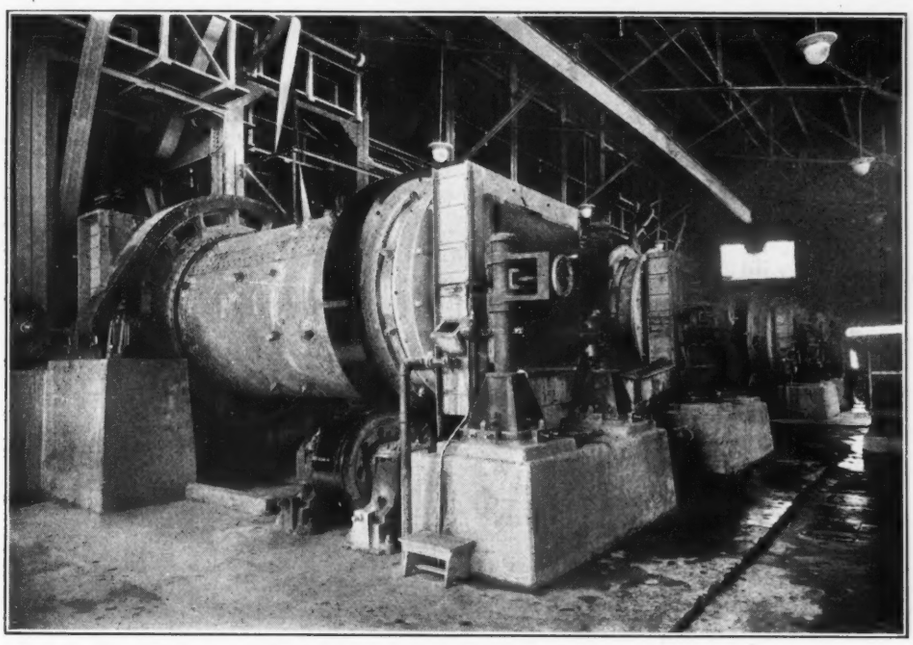
It soon developed that the tapered lining was a mistake, for the rods would not stay parallel and showed a tendency to kink. The lining was then made perfectly cylindrical and the entire shell tilted back about ¼ in. to the foot, the discharge end being the higher. This change was satisfactory, and in the ensuing tests it was proved that the roller mill ground a greater tonnage with less power than the ball mills regularly installed, and that, moreover, the product was so much freer from —200 mesh material that the flotation recov-



THE DISCHARGE END OF THE ANACONDA EXPERIMENTAL MARCY ROLLER MILL, WHILE IN OPERATION

ery was higher. (The chief flotation loss was in the finest slimes.) It was also proved that a mild steel was unsatisfactory for rods and that a high-carbon steel, as used for railroad rails, was preferable. A carbon content as high as 1 per cent was suggested by Mr. Marcy.

In 1918, the Phelps Dodge Corporation decided to remodel all of its concentrating plants, Old Dominion, Morenci, Tyrone, and Nacozari, and build a new plant on the sidehill south of Warren, Ariz, in the Bisbee district. As a result of the Anaconda tests and the excellent results which had been obtained with the Marathon mill, it was decided to experiment with a 6 x 12 Marcy roller mill at Nacozari. This mill was somewhat larger than the one used at Anaconda, and a tapered flange or diaphragm was bolted on to the discharge end, which tended to force the rods forward and keep them in the mill without the necessity of tapering the lining or tilting the entire shell. In addition to this, a circular door, mounted on columns and entirely separate from the mill, was designed to fit loosely into the large discharge opening, leaving an annular space through which the ground pulp could discharge. This door prevented all possibility of the rods coming out, eliminated splashing, and yet left it possible to observe the action of the mill at any time while running, and to remove worn rods or add new ones at a minute's notice. The large discharge opening also greatly facilitated relining and allowed large liner sections to be used. The low pulp level also thereby secured is a feature which millmen thoroughly understand from experience with ball mills having grate or center discharge, the principles involved being identical.



MARCY ROLLER MILLS AT THE BURRO MOUNTAIN BRANCH OF THE PHELPS DODGE CORPORATION, TYRONE, NEW MEXICO

The three steps in the development of this type of mill, covering the various methods of retaining the rods, are covered by U. S. patents 1,239,286, 1,309,210, 1,309,211, and 1,309,212.

The Nacozari ore is considered an exceptionally hard one, consisting of chalcopyrite in a quartzite gangue. The following data will indicate the character of work done in single-pass wet crushing of crude ore preparatory to roughing table treatment:

SCREEN TESTS (TYLER STANDARD)

	Feed		Discharge	
Mesh	Per Cent	Cumulative Per Cent	Per Cent	Cumulative Per Cent
+1½ in.	3.32	3.32	.....	.....
1 in.	13.50	16.82	.....	.....
¾ in.	31.02	47.84	.....	.....
3	2.28	50.12	.....	.....
4	5.90	56.02	.....	.....
6	8.40	64.42	0.76	0.76
8	4.90	69.32	1.36	2.12
10	4.64	73.96	4.46	6.58
14	3.64	77.60	5.92	12.50
20	3.44	81.04	8.44	20.94
28	2.50	83.54	9.24	30.18
35	2.30	85.84	9.68	39.86
48	2.36	88.20	9.38	49.24
65	1.76	89.96	7.60	56.84
100	1.40	91.36	6.80	63.64
150	1.16	92.52	4.72	68.36
200	1.12	93.64	4.24	72.60
—200	6.36	100.00	27.40	100.00

OPERATING DATA, 6 x 12-FT. MARCY ROLLER MILL

Dry tons feed per 24 hours	668.24
Total kw.-hr. per 24 hours	2,745.6
Kw.-hr. per ton feed	4.11
Kw.-hr. per ton—48-mesh material produced	10.65
Horsepower	153.3

When operating on a finer feed and grinding to the same fineness, the tonnage was increased considerably, a month's average showing a daily tonnage of 1,027. At this time, 0.25 per cent was on a 2-in. diameter screen; 1.10 on 1½; 4.28 on 1; 3.92 on ½; and 24 per cent on 4 mesh. The cumulative percentage on 4 mesh was therefore 33.55 when 1,027 tons was ground, compared with 56.02 when 668 tons was ground per 24 hours.

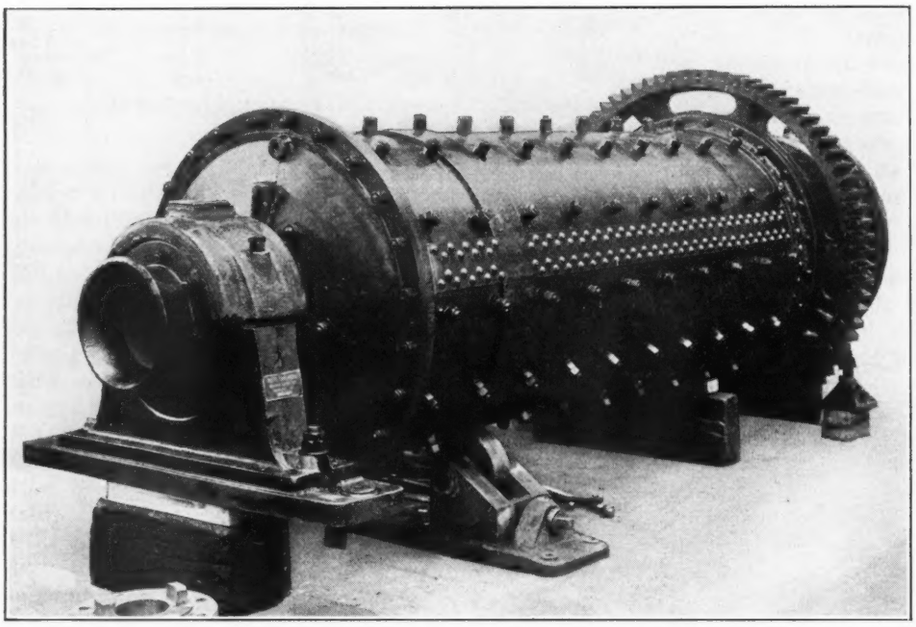
The results obtained with the Nacozari test mill, which began operating in June, 1919, led the Phelps Dodge Corporation to install these mills at that plant for all grinding operations. They were also chosen for the new Warren concentrator, and have been installed at Tyrone, forty-two mills altogether having been purchased.

The work at Nacozari is done in two stages. The primary Marcy roller mills, as already indicated, grind crude ore in one pass approximately from 1½ in. to 8 mesh for roughing tables, the sand tailings and middlings from which are dewatered and reground in secondary roller mills in closed circuit with Dorr classifiers, the finished product being 2 to 3 per cent +48 mesh for flotation feed. I believe that no grinding finer than all through 60 mesh has yet been done with this type of mill on a commercial scale, but, operating in closed circuit with a Dorr classifier, there would seem to be no reason why a pulp could not be slimed if necessary; possibly, however, not so economically as with a tube mill.

The 6 x 12-ft. Marcy roller mills are heavy, weighing over fifty tons each without the eighteen-ton rod load. Each mill is driven by a 150-hp. slip-ring or phase-wound rotor type of motor. Indications are that with a medium hard ore, or ore mixture, such as the porphyry and granite fed at Tyrone, which may be slightly more difficult to grind than the Inspiration or

Miami ores, about 2 or 2½ kw.-hr. will be required per ton of —1½-in. ring crusher product, ground to —10 mesh. For the total grinding to 2 or 3 per cent +48 mesh from the same crusher product, 6 or 7 kw.-hr. per ton would be a fair approximation. This would indicate that slightly less power is required for rod mills of this type than for ball mills, although without complete comparative data any statement on this subject is worth little.

The installation of Marcy roller mills recently made by the Mexican Corporation, Ltd., under the direction of Hugh Rose, is also of interest. Six 6 x 12-ft. mills are expected to take crusher feed of —1-in. ring and grind in closed circuit with Dorr bowl classifiers to 75 per cent —200 mesh.



A 4 x 10-FT. ALLIS-CHALMERS ROD MILL BUILT FOR DESLOGE CONSOLIDATED MINING CO.

In the Missouri lead district experiments are being made with the use of tubes along with rods for grinding. The St. Joseph Lead Co. recently went back to ball mills after using combined rods and tubes. I understand that the broken tubes are not removed, which would seemingly result in a considerable decrease in capacity. Small or bent rods or tubes probably are not efficient grinders, and if broken are a positive detriment. High-carbon rods which will break rather than wind up are no doubt advisable, but they should be removed before they become so small that they will do either, unless the mill is so operated that they are discharged as soon as they break, which is often the case.

ALLIS-CHALMERS USES LARGE RODS WITH CENTER DISCHARGE IN A TRUNNION-SUPPORTED MILL

When the early experiments had indicated an attractive future for the rod mill, several manufacturers entered the field. Experiments by the Allis-Chalmers company proved the advisability of using large (3 to 4 in.) rather than small (1 to 2 in.) rods, for two principal reasons: First, the capacity was greatly increased, and, second, the large rods would break the small rods before they would bend and kink, and the broken pieces would discharge automatically through the trunnion with the pulp. This eliminated all necessity of removing the head to take out worn and deformed rods, and allowed the use of trunnion-supported mills.

Following are some of the features of the Allis-Chalmers rod mill now on the market: The shell is of ¾-in. steel plate with riveted butt straps and cast-steel flanges. No manhole is provided, as the discharge spout is sufficiently large on all sizes of mills to admit a man if it is necessary to replace a liner bolt or make other interior repairs. Heavy sole plates are placed under the main bearings on both the feed and discharge end. The sole plate on the gear end is bolted to the sole plate under the pinion-shaft bearings, thus tying together the entire drive to the mill. The liners are of the ship-lap type, either chrome or manganese steel, held in place with ¼-in. bolts. If it is desired to remove the head of the mill for relining, supporting rollers are provided on which the mill may be turned when not supported at the trunnion. These may be backed away when not required.

The 4 x 10-ft. Allis-Chalmers rod mill shown in the illustration is one of two which have been in use by the Desloge Consolidated Lead Co. for over a year. These mills are each grinding in one pass about 450 dry tons per 24 hours, 45 per cent moisture, using a 13,000-lb. rod charge and consuming approximately 40 hp. Without a complete knowledge of the characteristics of the ore, data regarding operation mean little, however. The following screen tests will aid in obtaining some idea of the work these mills are doing:

SCREEN TESTS OF FEED AND PRODUCT

Mesh (Taylor)	Feed		Product	
	Per Cent	Cumulative Per Cent	Per Cent	Cumulative Per Cent
+3	4.85	4.85	....	.....
4	16.30	21.15	....	.....
6	11.33	32.48	0.26	0.26
8	12.41	44.89	2.61	2.87
14	36.30	81.19	27.60	30.47
20	11.20	92.39	18.31	48.78
28	3.88	96.27	12.16	60.94
35	1.62	97.89	8.85	69.79
48	0.64	98.53	5.33	75.12
65	0.34	98.87	4.26	79.38
100	0.24	99.11	3.84	83.22
150	0.06	99.17	1.87	85.09
200	0.17	99.34	4.11	89.20
—200	0.66	100.00	10.80	100.00

These tests supplement those previously given in showing the granular character of a rod-mill product.

Six 5 x 10-ft. Allis-Chalmers rod mills are now being built for the Homestake Mining Co. These are designed to work in closed circuit with Dorr classifiers and are estimated to have a capacity of approximately 200 tons per mill, grinding from ¾ in. to 60 mesh.

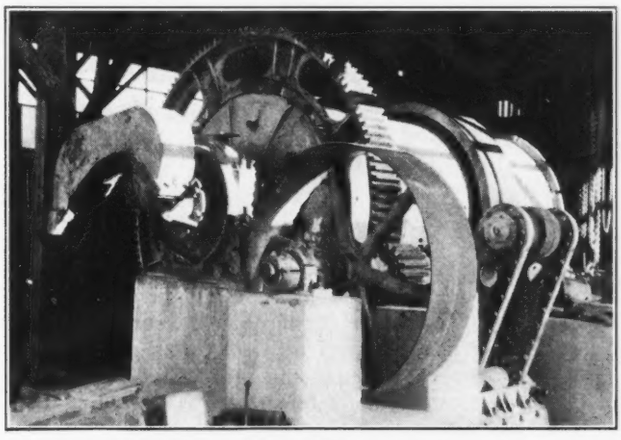
For feed crushed to 1 in., on which the rod mill will do its best work, an initial charge of 50 per cent 4-in. rods, 25 per cent 3-in., and 25 per cent 2½-in. rods is recommended by the Allis-Chalmers company. For regrinding, however, 3-in. rods are the largest size recommended. Steel consumption has been found to be

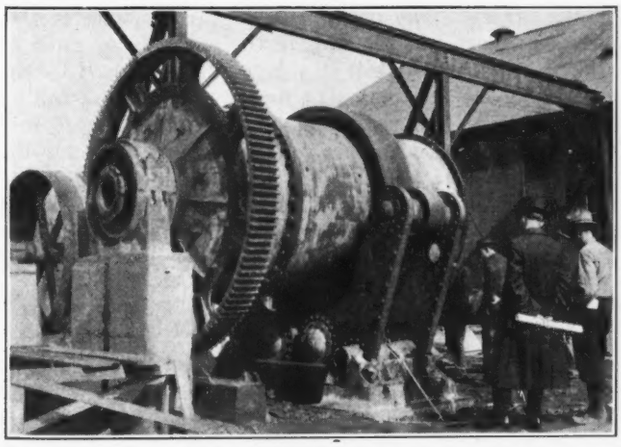
approximately the same as the liner and ball consumption in a ball mill grinding the same ore.

A 4 x 10-ft. mill working on *dry* ore is in operation at the plant of the D. W. Jones Co. in Denver, Col., crushing a fairly hard porphyry from all —¾ in. to 22 per cent +40 mesh. The capacity of the mill is about 125 tons per 24 hours; the rod charge, 8,000 lb.; and 40 hp. is used. Greater capacity could be secured by increasing the weight of rods in the mill. In this mill, the discharge end is carried on roller bearings and a grate discharge is used. The mill operates at 26 r.p.m.

Cole-Bergman Mill Features Ball Bearings

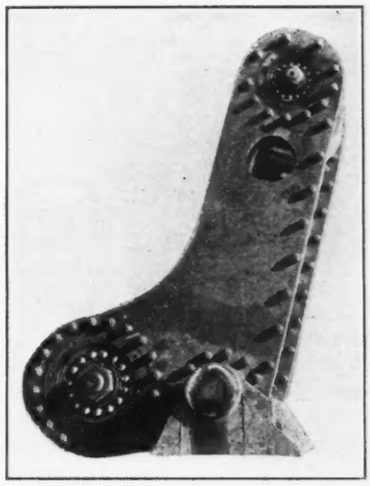
Another type of rod mill which has sprung into prominence in the last year is the Cole-Bergman mill. This was first tried out in the New Cornelia test plant at Ajo, Ariz., during 1919, and proved about 28 per cent more economical in power than a ball mill and also indicated about the same saving in costs. Unfortunately, the tests were concluded before a set of linings had been worn out. The mill was 5 x 10 ft. inside dimensions and operated at 19 r.p.m. About 90 hp. was required, the rod charge being 16 tons of 2-in. and smaller rods, and the mill ground about 250 tons per 24 hours of "very hard" ore from —1 in. to —48 mesh. Mr. Cole tells me that a great deal of experimental work was done in varying the point of discharge from the periphery to the center, and that several discharge heads were constructed for demonstration purposes. Central discharge was found to be the best for wet work, inasmuch as this assured a proper amount of mortar-like pulp throughout the mill to coat the rods.





THE 5 x 10-FT. COLE-BERGMAN ROLLER ROD MILL

With a full charge of rods of various sizes in a mill, and a proper dilution, there is probably little likelihood of rods cascading and uselessly splashing in a deep bath of pulp. The Cole-Bergman mill is a trunnion-discharge mill, although the discharge end is carried on roller bearings. These bearings carry 85 per cent of the revolving load of the mill and are equipped with "SKF" ball bearings, which the makers of the mill claim should save 16 per cent of the power required with other mountings. A part of one of these supports is shown in the illustration. The outer race of the main bearing is more than 12 in. in diameter, and the 1¾-in. balls are in double rows. The balls in the smaller bearing are 1 in. in diameter. The spherical trunnion bearing is 10 in. long. The revolving part of the mill weighs 41,000 lb. and the normal rod load for the mill is 32,000 lb. Each of the four ball bearings carries about eight tons. These figures all apply to the standard 5 x 10-ft. mill.



ONE OF THE FOUR BEARINGS WHICH CARRY 81 PER CENT OF THE WEIGHT OF THE COLE-BERGMAN MILL

Eleven Cole-Bergman mills have so far been built, the installations including the concentrator of the Iron Cap Copper Co., at Copper Hill, Ariz., and the Santiago concentrator of the American Smelters Securities Co. at Santa Barbara, Chihuahua, Mexico.

The Iron Cap concentrator went into operation last June with rod mills as part of the original equipment. While building the plant, the Iron Cap ore was treated in one section of the Inspiration concentrator, which was rented and segregated for that purpose. A good opportunity was, therefore, given for comparing the work of the 8 x 6½-ft. Marcy ball mill, which is the standard grinding unit at Inspiration, with the 5 x 10-ft. Cole-Bergman rod mill, which afterward operated on the same ore in the new plant. The Inspiration company handled the Iron Cap ore for about six months. In that time it was shown that the power required to crush and grind the ore from run-of-mine size to —48 mesh was 14.96 kw.-hr. per ton, allowing the same power for preparatory crushing that is used for Inspiration ore; namely, 0.46 kw.-hr. per ton for crushing to 2 in. The power input to the Marcy mill motors in the Iron Cap section was 14.5 kw.-hr. per ton. It also developed that only 600 tons of Iron Cap ore could be handled in a section which formerly handled 1,000 tons of Inspiration ore, thus establishing a comparative friability factor for the two ores.

Grinding this same Iron Cap ore in the rod mills of the new concentrator, the coarse crushing and conveying from run-of-mine size to 1½ in. requires 0.638 kw.-hr. per ton, and the fine grinding from 1½-in. size to all —48 mesh requires 9.0 kw.-hr. per ton, making a total of 9.638. This compares with 14.96 kw.-hr. per ton required by the Inspiration equipment, showing

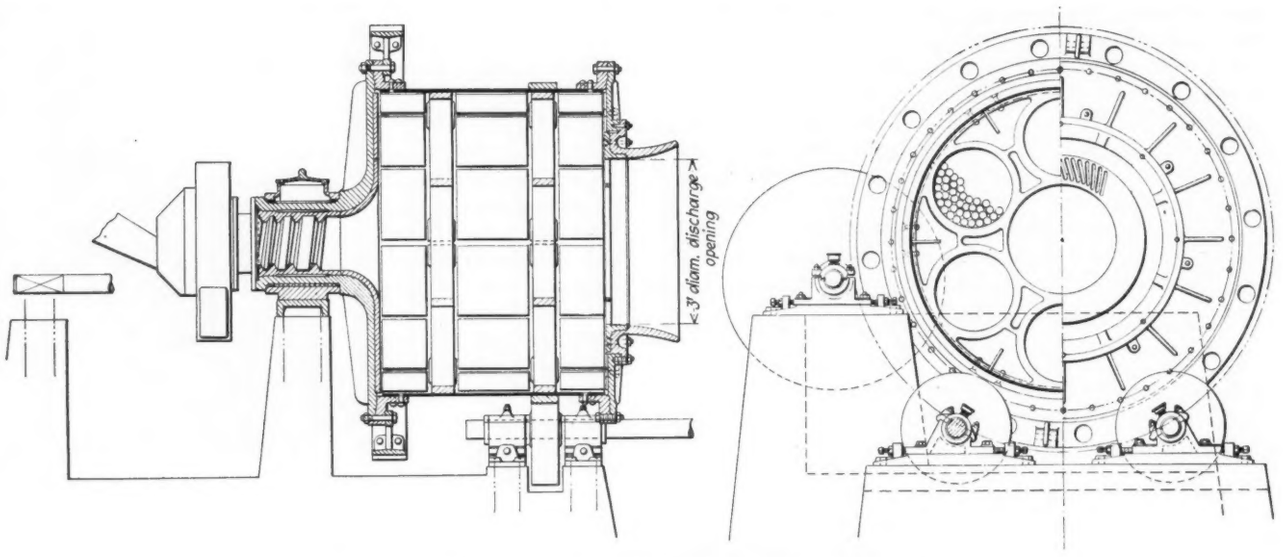


DIAGRAM OF A 5 x 4-FT. FORRESTER-HENDY ROD MILL

an apparent saving of 35 per cent, due to the use of rods and ball bearings, and also possibly to the fact that less of the ore was slimed, although I have not the comparative screen tests to show this. The fact that stage grinding is done at Copper Hill, whereas one mill takes 2-in. ore and produces a finished product at Inspiration, also must be considered.

The Iron Cap flow sheet is simple. The feed, about 325 tons per day, is supposed to pass 1½ in., and 40 per cent is +¾ in. This is mixed with 25 per cent water, in a 5 x 10-ft. rod mill, No. 1, to 1 per cent +8 mesh, and divided among four roughing tables. Sufficient water is added to make the tables work properly. The concentrates amount to about 8 per cent of the feed and contain slightly over 50 per cent of the total copper. The tailings pass to a Dorr duplex, Style "D," classifier in closed circuit with the No. 2 5 x 10-ft. rod mill. A little more water has to be added to give the correct ratio for the classifier overflow, which goes direct to Inspiration type flotation machines. The flotation tailings are deslimed with drag belts, the sands are retabled for precautionary reasons, and the slimes and sand table tailings go to waste. The copper recovery is over 95 per cent. No thickening is done between the various stages. This brief summary of operations is given to indicate how well the rod mill fits into a flow sheet of this type.

The rods used in the primary mill are what are known as "3-in. rounds," manufactured by the Colorado Fuel & Iron Co., and cost, at least until recently, about 4¼c., f.o.b. Globe, Ariz. These are removed after being reduced to approximately 2-in. size. Thus, the primary mill contains nothing but relatively large rods, well suited to breaking the hard quartzite in the ore. The rods taken from the primary mill are used in the secondary mill, where they are retained until worn to about ⅞ in. They are taken out when of this size because it is economical to do so. There has never been difficulty with crooked rods, winding up of rods, or broken rods. No regular interval for taking out worn rods is observed. On change days or at intervals of about one week, the condition of the rod load is observed through the discharge opening and the small rods are removed. Each mill averages about 1.30 lb. of rods per ton of ore. It is still too early to give definite data as to wear of linings. These liner plates are of cast steel, made in El Paso. So far, a smooth liner has been used, but it is likely that a waved type would give better results.

The Forrester-Hendy Mill Carries Rods in Individual Compartments

Another totally different type of rod mill has not yet been put on the market, but is now undergoing large-scale tests. This, called the Forrester-Hendy rod mill, after the patentee and maker, is to be made by the Joshua Hendy Iron Works, and some idea of its design may be had from the illustration. The mill is divided into six cylindrical compartments, each containing a separate charge of rods. The axis of rotation is not within the space inclosing the rods, and the grinding action will, therefore, not be the same as in the mills already discussed. The mill is also much shorter than other rod mills, 5 ft. diameter x 4 ft. long. The mill of this size has a 3-ft. discharge opening and is designed to operate at 28 r.p.m. Great claims for power economy are made, it being asserted that the power required is only about one-quarter of that consumed by any other type of ball or rod mill of the same capacity. This is, of course, because the mill is balanced, there being three compartments filled with rods, aiding rotation on the descending side while work is being done on the others. The power curve characteristic is also doubtless more smooth than in the case of rod mills of other types, for which it is a jagged line, caused by the rods being elevated near the top of the mill and falling to the bottom. The starting torque in a balanced mill of this kind would certainly be much less than for the ordinary ball or rod mill, in which the entire charge must be lifted as so much dead weight, a fact which requires attention in designing the motor drive. More data should be obtainable later in the year regarding the performance of this mill.

The Field of the Rod Mill

Summing up, then, it is seen that rod or roller mills are being actively developed by several companies and have every possibility of being successful competitors of ball and tube mills in certain fields of work. They are adapted only to grinding through a comparatively

narrow size range in individual mills, and work done up to this time indicates that they cannot take feed as large as is often given to a ball mill, nor is it yet proved that they are superior or equal to tube mills where material finer than 100 mesh is desired. Theoretically, however, there is no reason why they should not be efficient grinders for the finest sizes. They do not seem as adaptable to small as to large units, for a small mill could not carry sufficient weight of rods to break up large or tough ore particles, for the rods act along a line contact. They have been successfully used for dry crushing, although this is not generally desired. There would seem to be no reason why rods could not be substituted for balls in mills of the Krupp type which discharge through perforated plates forming the cylindrical surface of the mills. I have never heard of their use in this way, however; removal of the worn rods would be an inconvenience.

In rod mills, a waved type of liner is probably superior to a smooth surface. The indications are that liner consumption will be possibly one-half pound per ton less than for ball mills. Also, the forms are simpler and can be made more cheaply. There are no grates or manholes to provide for. The consumption of steel rods appears to be slightly less in the rod mill than of balls in the ball mill. In this connection, it is important to remember that steel in the form of rods or rounds is a standard article, cheaply made, and obtainable from many rolling-mill plants. Competition is active, and there are no trade name handicaps. Statistics covering several years indicate that balls sell for about double as much as rods. Freight, however, will be perhaps half of the delivered cost and is about the same for rods as for balls. Power consumption would seem to be somewhat less as a general rule for rod than for ball mills of equal capacity, the exact figures depending upon the grinding problem and the type of mill selected.

Indications are that flotation concentrates are more easily filtered when the ore has been ground in rod mills than when balls have been used as the grinding medium. If this be true, it would seem to be a logical result of the lessened amount of slime produced in rod-mill grinding, inasmuch as it is this which clogs the canvas and results in a thin and wet filter cake.

Most of the rod mills described have not been in use long enough to prove the extent of their applicability or to afford fair comparisons with ball or tube mills. The information given indicates possibly more of their advantages than disadvantages, but it may conservatively be said that they are machines of considerable promise for certain classes of work.

Mineral Production Curves

By G. M. Schwartz
Written for *Engineering and Mining Journal*

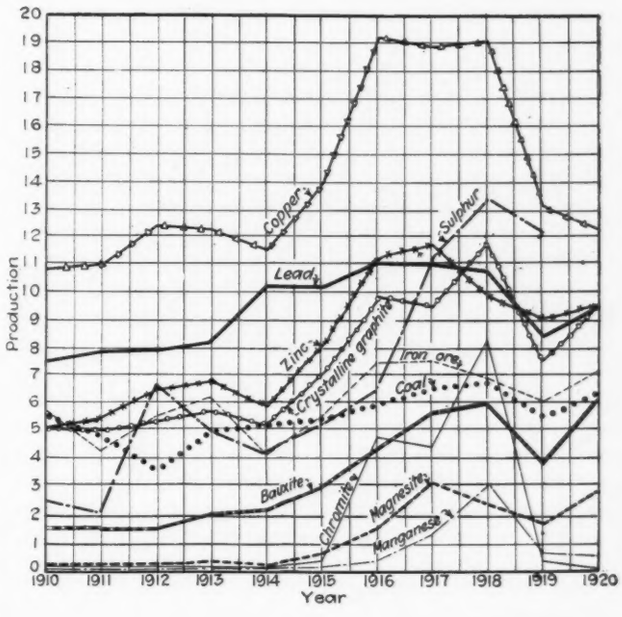
THE CURVES illustrated indicate the trend of the production of eleven important mineral products during the years 1910 to 1920 inclusive and have been plotted from U. S. Geological Survey and *Engineering and Mining Journal* statistics. They suggest that already there is a return to normal, and that for some metals the production is now below normal. The greatest rise in production occurred in minerals entering into munitions of war, namely copper, zinc, sulphur, chromite, manganese, and graphite.

The following table gives the production units used in plotting the curves:

Mineral	Unit
Iron ore, long tons	1,000,000
Bauxite, long tons	100,000
Sulphur, long tons	10,000
Coal, short tons	10,000,000
Magnesite, short tons	100,000
Manganese, short tons	100,000
Chromite, metric tons	10,000
Copper, lb	100,000,000
Lead, lb	100,000,000
Zinc, lb	100,000,000
Graphite, lb	1,000,000

A few details of individual minerals are interesting. Iron ore and coal, which rose less rapidly, have slumped less than the other products. This is due in part to the large normal production and to the fact that labor enters into the production to such an extent that a large increase was difficult during the war, and the demand was not excessively increased. The increase in steel was partly compensated by the lack of demand for ordinary construction work. Thus it seems that steel, ordinarily taken as a barometer of business, is not as sensitive as copper, for instance. It is noticeable that 1914, a year of dull business, shows a tendency to decreased production of all important minerals except lead.

Minerals not normally produced in large quantities, *i.e.*, chromite, magnesite, manganese, dropped back with



the increase in imports and the lessened demand at the end of the war. Of all the metals, copper shows the greatest increase and is probably now experiencing the greatest depression.

Copper, lead, iron ore, chromite, manganese, and coal approached normal production in 1919 and 1920. Zinc is the only metal of any importance that has failed to return to pre-war levels; recent reports indicate that it has about reached normal in the last few months. If the normal annual increase in production is considered, many minerals are now below the production that might be expected. This is accounted for by the slackened demand due to the ending of the war and depressed business conditions, and also by the large stocks accumulated during the peak production. Even the large uses in war materials did not utilize the largely increased production of 1916 to 1918.

The Engels Copper Mine and Mill, California

Low-Grade Copper Ores Made Profitable by Flotation—Ore Deposit Of Unusual Type—Large Orebodies Mined by Shrinkage Stoping—Improvements in Equipment and in Organization and Management

BY GEORGE J. YOUNG
Western Editor, *Engineering and Mining Journal*

THE ENGELS COPPER CO. is one of the most important and well-directed copper producers of California. With careful management, a comparatively low-grade bornite and chalcopyrite deposit has been made of economic importance, thanks in large measure to the flotation process of concentration.

The mines are in Plumas County, and have the advantages of railroad connection with the Western Pacific at Paxton by the Indian Valley R.R., which terminates at Engels. This branch railroad is twenty-two miles long. The mining property is in a less accentu-

GENERAL VIEW OF UPPER CAMP AT ENGELS MINE

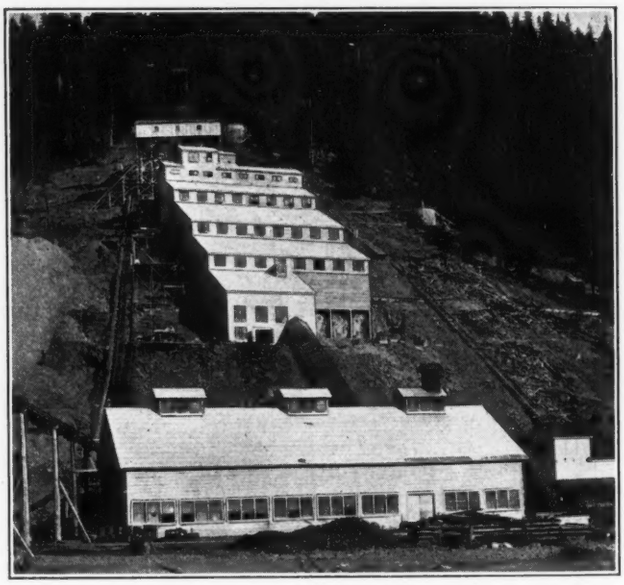
ated portion of the Sierras, on the western slope, at an elevation of approximately 5,000 ft. The region is heavily timbered and is on the whole a delightful mountain country.

The early operations at the Engels mine were of a desultory character. The property has been known since the 80's. I noted in the issue of the *Engineering and Mining Journal* of Aug. 30, 1902, an advertisement soliciting the sale of stock by the company, which at that time was organized on a capitalization of $1,000,000. It was then proposed to erect a smelter to treat the oxidized and richer sulphide ores, which were of comparatively high grade. In 1914, a smelter was constructed, but it was never operated, and until late in 1914 ores were shipped to Garfield, Utah. Late in 1914, a flotation mill was constructed. Since that time, owing to the success of the flotation process, the tonnages mined steadily increased, and in 1919 a 750-ton flotation mill was installed. In the same year capitalization was increased from $2,000,000 to $5,000,000. In September, 1919, Robert A. Kinzie, well known through his successful management of the Alaska-Treadwell group of mines, was engaged as operating engineer. Mr. Kinzie initiated a diamond-drilling campaign which had for its objectives the delineation of the orebodies in depth, width, and length. The results of this work were of importance, for they proved up sizable reserves of the low-grade ore characteristic of the deeper development. The next important work was the rehabilitation of the operating plant. Of the two mills, the upper and older mill was abandoned and the milling operations were restricted to the new mill, which was completely overhauled and its capacity increased. Living quarters, shops, and mechanical plant were greatly improved, and operations were systematized into a closely knit unit in charge of excellent operating men.

TWO OREBODIES MINED

Two orebodies are being mined—one, the Engels mine, known as the upper mine, and the other, the lower or Superior mine, which is at Engels, close to the concentrating mill, two miles southwest of the upper mine and 1,200 ft. lower in altitude.

The ore deposits have excited considerable discussion among mining geologists. According to H. W. Turner and A. F. Rogers (*Economic Geology*, Vol. 9, p. 359), the ores are of direct magmatic origin, and the development of chalcocite and some covellite by replacement of bornite was due to the work of ascending heated alkaline waters, an example of upward secondary enrichment. L. C. Graton and D. H. McLaughlin (*Economic Geology*, Vol. 12, p. 1) subsequently made an extended study both of the ores and the deposits. Their conclusion was that the ores are of pneumatolytic and hydrothermal origin, and this interpretation appears to be the accepted one. The Engels ore deposit occurs in a "basic differentiate of the great Sierra Nevada batholith of granodiorite." The rock can be termed for practical purposes diorite.



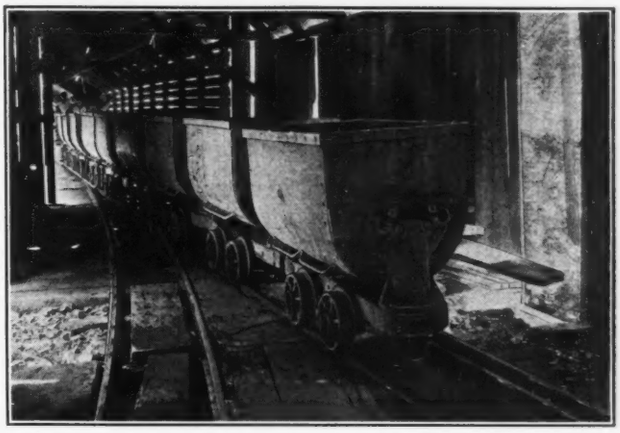
SUPERIOR MILL, MACHINE SHOP IN FOREGROUND

According to Graton and McLaughlin, "commercial ore at Engels is distributed in somewhat indefinitely bounded shoots, of which several have been opened and which collectively constitute a deposit of roughly elliptical plan within the modified norite (diorite). As a rule the ore merges into the country rock, and all gradations exist, from scattered minute sulphide grains to heavy masses of ore with subordinate gangue. Bornite and chalcopyrite, the most abundant ore minerals of the Engels deposit, were found mainly under hydrothermal conditions, together with a small amount of enargite, tetrahedrite and sphalerite. Magnetite, ilmenite, and hematite, which apparently had continued to develop during the early period of bornite formation, ceased to form as conditions became milder, and became surrounded or rarely veined by the bornite and chalcopyrite

ORE CHUTE AT UPPER MINE

which continued to increase. The bornite is four times as abundant as the chalcopyrite. Calcite is abundant in most of the specimens. The orebody is capped by a moderate but irregular thickness of oxidized and leached rocks."

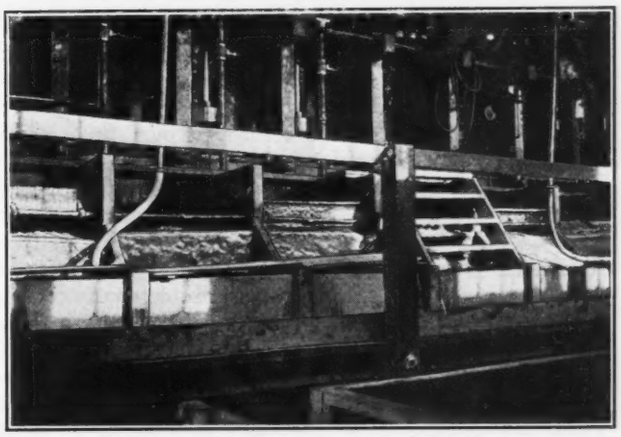
At the Superior mine there is practically no oxidized surface zone, but in other respects the deposits are similar. "Bornite and magnetite are the most abundant ore minerals. The magnetite appears as large grains surrounded by a cement of bornite. The latter also occurs as fine flecks or irregular veinlets on the magnetite; it is clearly of later age and in part a replacement of the iron oxide. Association between the two minerals is more intimate than in the Engels ore, and the magnetite seems to have been more generally attacked by the bornite than is the case in the larger deposit. The absence of specularite and ilmenite is noteworthy. Chalcopyrite is more plentiful than at Engels. A few small blebs of galena were observed. Chalcocite is present in subordinate amount intimately associated in all cases with the bornite." There is a further discussion of the Engels deposits by the same authors in *Economic Geology*, Vol. 13, p. 81.



ORE TRANSPORTATION AT ADIT OF UPPER MINE

From a miner's standpoint the deposits belong to that class where the ore shoots follow a consistent trend, southwest and northeast in this instance, and are associated with a definite type of rock, diorite. The shoots of pay rock do not differ in broad characteristics from the scantily mineralized rock, nor are they generally defined by walls or other characteristics usually serving as a guide to the miner. There is a gradual impoverishment of copper minerals as the limits of a shoot are approached. In appearance, the ore ranges from fresh-looking diorite to a more or less altered diorite. The ore minerals do not to a conspicuous degree occupy rock-fracture planes, but are in masses, lenses, and veins in the body of the rock. Silicification is conspicuously absent, and the presence of calcite in relatively small amount is of no special service in following the zone of mineralization. Visual inspection of the rock and analysis are the only methods of distinguishing the ore. Diamond drilling has been effective in determining the position and probable limits of ore shoots.

The Engels deposits are well worth study by mining engineers, as they typify an unusual kind of ore deposit



FLOTATION UNIT IN SUPERIOR MILL

and one that might be duplicated under similar conditions. The incidental associations of bornite with diorite, having some of the characteristics of magmatic segregation, should be rather carefully examined, in my opinion, as the Engels deposits prove that valuable copper ore shoots might be thus indicated.

Mining Plant and Methods

At the upper mine a three-compartment shaft connects with an adit level, through which the ores are hauled by electric locomotive, trolley and storage-battery types, to a bin. From the bin the ore is fed by steel apron feeders to a belt conveyor, which discharges into an 18 x 36 jaw breaker. The ore is then loaded from a receiving bin into a Riblet bucket tramway, by which it is transported to the mill at the Superior mine. The shaft is arranged for skip hoisting and serves the levels below No. 6, the adit level. A two-drum Nordberg hoist, driven by a 150-hp., 2,200-volt motor, serves the shaft. The compressor equipment consists of a Sullivan angle-type, 18-11-14 size, a belted Imperial Type 10, 18-11-16 (originally steam driven), and a belted Imperial Type 10, 28-17-24 size, all motor driven. Tool sharpening and timber shops complete the surface plant. A commodious dormitory serves for the working crew. A club room is also provided. An old bucket tram is used for transporting supplies to the upper mine.

Practically all of the richer ores near the surface have been stoped, and a caved area at the surface of the Engels mine indicated the extent of the underground workings. The stopes are operated on the shrinkage system, and chute loading is the prevailing practice. As a rule the stopes stand well, except in the oxidized zone, and on the transportation and haulage levels timber is required only at the chutes. The section of the drifts and crosscuts used for transportation is usually arched. The orebody at the upper mine is 120 x 800 ft., and pillars are left in for support transversely.

At the Superior mine a three-compartment shaft, served by a motor-driven, two-drum hoist, delivers the ore by skip to the mill bin, which is near the shaft collar. The compressor equipment consists of a Sullivan angle-type compressor, 16-9¾-12, belt driven by a 75-hp. induction motor, 2,200 volts, and an Ingersoll-Rand Type 10, 28-17-24, belt driven by induction motor. Both compressors are in a separate building, in which is housed an alternating-current generator direct connected to an Allis-Chalmers hydro-turbine of 485 brake hp. This unit operates under a 440-ft. head and supplies 2,300-volt current, 3 phase, 60 cycles. It is used only for emergencies, as the power current is supplied from a hydro-electric plant and is bought by the company.

The Superior orebody is mined in part by a glory hole and in part by shrinkage stoping. An adit gives access to the workings from a point on the general level of the machine shop and compressor building. The shrinkage stopes are laid off with rock pillars 100 ft. apart and ore pockets at 25-ft. centers. A raise 8 ft. square outside dimensions, protected on either side by pillars 10 ft. thick and constructed as shown in Fig. 1, is carried up as a preliminary to stoping. Short horizontal drives cut through the side pillars at 30-ft. vertical intervals give access to the stope. These are plugged up as the stope is extended upward. A ladderway, drill chute, and rock chute occupy the manway, which also serves as a pipeway. The drill chute is a box made of four boards. It is open at the bottom and top (Fig. 1). The drills are hoisted and lowered through this chute by a "Tugger" hoist, which also serves for hoisting the timbers used in the construction of the manway. Necessarily, the disposition of rock and manway pillars varies, as sometimes the ore shoots are inclined. Some difficulty is experienced with the inclined ore shoots, which may flatten to such an extent as to interfere with the downward movement of the ore. This has been overcome by the use of a scraper and "Little Tugger" hoist. In some cases the access manway is built up into the stope without pillar protection. Under these circumstances it is built up three or four feet above the broken rock and rock is filled in around it.

Stoping is done with the Leyner Ingersoll No. 148. Stopers are used in raising and jackhammers for plug work. In drifting, an advance of 3.5 ft. is made per round. Never less than twelve and up to thirteen to sixteen 5-ft. holes are required per round. The "toe-

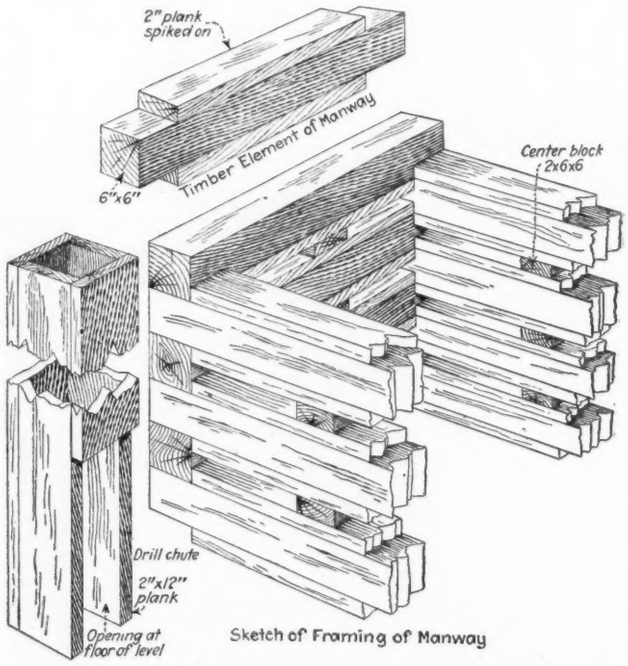


FIG. 1. DETAILS OF MANWAY TIMBER FRAMING AND DRILL CHUTE

cut" required two center, two side, three lifters, three breast, and three back holes. This cut has been displaced by the "pyramid cut," which requires four holes to the center, three top, three lifters, and three breast holes. In addition, two holes are required in between and three bottom holes. Starters are 2¼ in. and finishing drills 1¼ in., decreasing in size ⅛ in. per drill. Drills are changed every twelve inches. A 50-lb. box of 40 per cent 1⅛-in. power is required per round.

In the Superior mine short crosscuts were put into the stope, and an elevated shoveling platform, car high, was put in, practically the same as is used in the Homestake mine. This method of loading cars has been discarded in favor of chute loading.

The mining is relatively simple, and as the ground holds well in drifts, crosscuts, and stopes, timber support is confirmed to manway raises and to chute construction.

Omitting the ores characteristic of near-surface con-

ditions in the Engels, the ore mined from the lower levels is low grade, ranging from 2 to 3 per cent copper. About one ounce of silver is recovered for 72 lb. of copper, and gold is present in the ratio of one ounce to 98 oz. of silver. Recoverable gold and silver approximate 60c. per ton of ore. The principal copper mineral is bornite. Accompanying it are chal-

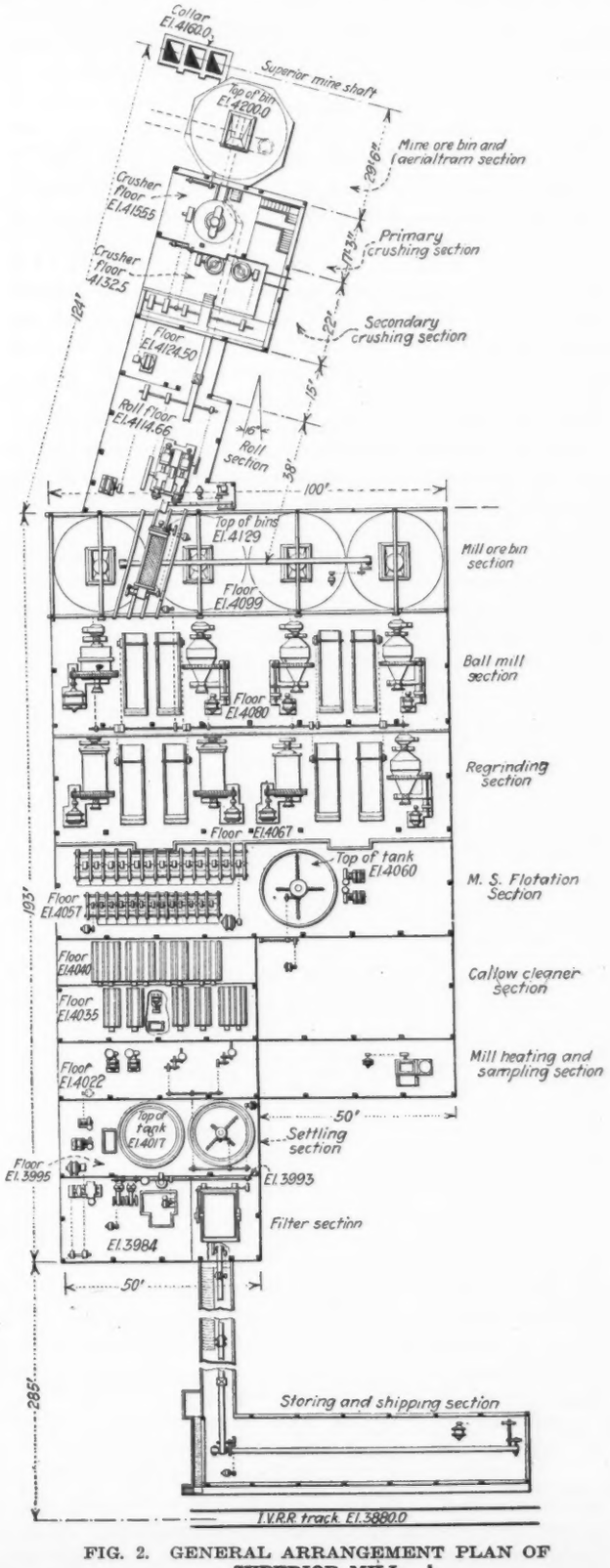


FIG. 2. GENERAL ARRANGEMENT PLAN OF SUPERIOR MILL

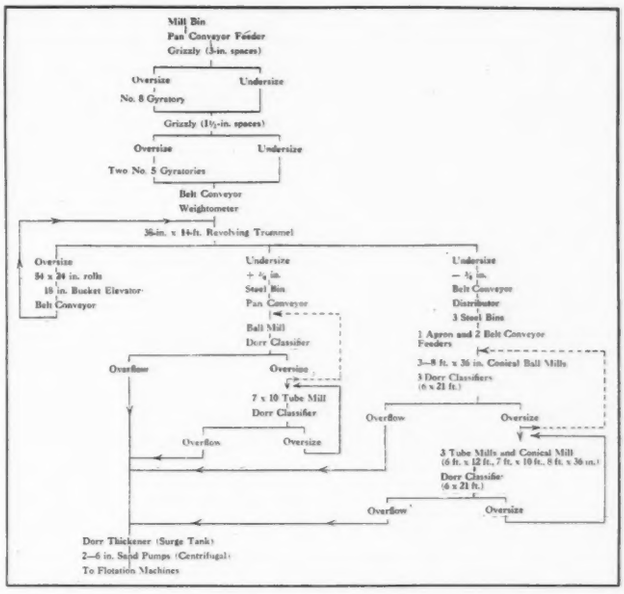


FIG. 3. FLOW SHEET OF CRUSHING AND GRINDING SECTION OF THE SUPERIOR MILL

copyrite, incidental amounts of chalcocite, and small amounts of cuprite. Magnetite and accessory heavy minerals are in important amounts from a metallurgical standpoint. A recovery in excess of 80 per cent is made, and concentrates produced are approximately 30 per cent copper. This is exceptionally good work, as the percentage recovery includes part of the oxidized copper minerals.

Before the railroad was built to Engels, the nearest rail point was Keddie, on the Western Pacific, about twenty-eight miles away. The low-grade ores could not be concentrated by the ordinary methods available, on account of the accompanying heavy minerals, which diluted the copper concentrates and gave a concentrate too low in grade to be shipped. Smelting was considered to the extent of erecting a blast furnace, but this furnace, as before mentioned, was never operated. The applicability of the flotation process was pointed out, and a mill designed by the Minerals Separation Co. was installed. A satisfactory shipping concentrate was produced, and operations continued on a larger and larger scale. The first mill was of 150 tons' daily capacity, but was brought up to 225 tons per day. This was in 1914. In 1919 a 750-ton flotation mill was completed at the Superior mine, and in 1920 milling, as already stated, was discontinued at the upper mine and restricted to the new mill, which was completely overhauled and its operating capacity increased to 1,500 tons per day. The mill is constructed on a steep side hill. The plan of the mill is shown in Fig. 2.

The important milling operations are comminution, thickening of pulp, flotation, cleaning of flotation concentrates, dewatering, and tailing disposal. The flow sheet of the breaking, crushing, and grinding section of the mill is given in Fig. 3. To secure a satisfactory recovery and at the same time high-grade concentrates, fine crushing is essential, and at the time I visited the mill the screen analysis of the flotation feed showed 12 per cent on 100-mesh; 50 to 60 per cent on 200-mesh, and 28 to 30 per cent passed a 200-mesh screen. The tonnage ranged from 600 to 700 tons per twenty-four hours. The Dorr classifier overflow prod-

uct is received in a 20 x 10 Dorr thickener, which serves as a surge tank to maintain the pulp level in the flotation machine and the proper dilution of the pulp, which is kept at a ratio of four to one. The flotation equipment consists of two M. S. machines, one 24 in., twelve cells, and one 18 in., twelve cells. In addition, there are eight Callow roughers and seven Callow cleaners. By the use of two 3-in. centrifugals, intermediate products can be returned to the cleaners or to the Dorr thickener. Final flotation concentrates are received in a 16 x 16 Dorr thickener, the overflow being caught in a 16 x 16 tank and settled (settled concentrates are pumped back to flotation by a 2-in. centrifugal). The thickened concentrates are dewatered on two Oliver filters (8 x 6 and 12 x 8) and discharged by a conveyor into storage bins, from which they are loaded into railroad cars. The flotation flow

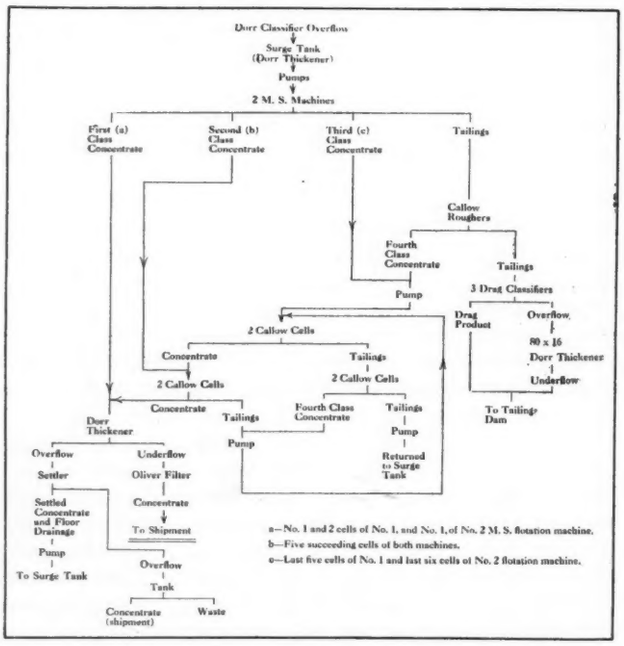


FIG. 4. GENERAL FLOTATION FLOW SHEET

sheet is varied from time to time, but the general scheme is indicated in Fig. 4.

During February, 1921, 22,935 tons was milled, or an average of 819 tons per day. The concentration ratio was 15.254:1, the indicated recovery 83.161, and

TABLE I. MILLING COSTS AND DETAILS AT THE ENGELS MINE, FEBRUARY, 1921

	Per Ton		Per Ton
Crushing	$0.0304	Dewatering (tailings)	$0.1012
Classifying	.0015	Power	.2763
Grinding	.1428	Assaying	.0058
Regrinding	.0856	General	.0123
Conveying	.0081	Heating and lighting	.0502
Pumping	.0048	Boarding house loss	.0175
Concentrating	.1073		
Filtering	.0221		$0.8659

Steel—5 in. balls, lb. per ton	$1.6394
2-in. balls, lb. per ton	.9003
Total steel balls	$2.5397
Liners, lb. per ton	.5861
Kw.-hr. per ton milled	22.89
Bbl. lime per day	4.964
Oil, lb. per ton milled	1.1707

the actual recovery 83.116 per cent. The milling costs for this month, together with significant details, are given in Table I. An analysis of concentrates is as follows:

Copper, 32.05 per cent; silica, 25.60; iron, 14.70; aluminum, 10; sulphur, 15.60; and lime, 1.40 per cent.

From the company's annual report the tonnage milled during 1920 was 239,612, averaging 2.21 per cent copper and yielding 14,519.9 tons of concentrates, averaging 29.76 per cent copper. Tailings averaged 0.45 per cent copper. The metals recovered were 8,571,569 lb. copper, 119,165.4 oz. silver, and 1,217.9 oz. gold.

Acknowledgment is made of the courtesy of Robert A. Kinzie in supplying data and drawings, and to William R. Lindsay, W. I. Nelson, and W. E. Kyle, who assisted me during my visit to the mine and mill.

Record Phosphate-Rock Production in 1920

The phosphate-rock industry in the United States in 1920, according to figures from all producers compiled early in April by the U. S. Geological Survey, made a record far surpassing that of any previous year. The quantity of phosphate rock mined and sold was 4,103,982 long tons, or nearly a million tons more than in the record year 1913. The total receipts from sales was $25,079,572, or more than twice as much as in any other year. The average price per ton for the entire output was $6.11, as compared with $5.10 in 1919.

Florida's output more than doubled, the quantity of land-pebble phosphate increasing by more than one and one-half million tons. South Carolina produced 27 per cent less than in 1919, but Tennessee increased her output 100,000 tons, or 18 per cent. A most notable feature of the year was an increase of 223 per cent in the production in Idaho and Utah. The Western output, most of which was made by Idaho, jumped from 17,000 tons in 1919 to more than 55,000 tons in 1920.

PHOSPHATE ROCK EXPORTED IN 1920

	Long Tons	Value
High-grade hard rock	344,896	$4,496,457
Land pebble	693,355	5,593,814
All other	31,761	500,904
Totals	1,070,012	$10,591,175

The total exports in 1919 were 378,731 long tons, valued at $3,567,982. The following tables summarizes the industry for the last eight years.

PHOSPHATE ROCK MARKETED IN AND EXPORTED FROM THE UNITED STATES, 1913–1920

Year	Quantity Marketed, Long Tons	Exports, Long Tons	Proportion of Exports to Domestic Production, per Cent
1913	3,111,221	1,366,508	44
1914	2,734,043	964,114	35
1915	1,835,667	253,421	14
1916	1,982,385	243,678	12
1917	2,584,287	166,358	6
1918	2,490,760	143,455	6
1919	2,271,983	378,731	17
1920	4,103,982	1,070,012	26

PHOSPHATE-ROCK MINED AND SOLD IN THE UNITED STATES 1919–1920

State	1919 Quantity, Long Tons	1919 Value	1919 Average Value per Ton	1920 Quantity, Long Tons	1920 Value	1920 Average Value per Ton
Florida:						
Hard rock	285,467	$2,452,563	$8.59	400,249	$4,525,191	$11.31
Soft rock	14,498	196,318	13.54	13,953	190,551	13.66
Land pebble	1,360,235	5,149,048	3.79	2,955,182	14,748,620	4.99
	1,660,200	$7,797,929	$4.70	3,369,384	$19,464,362	$5.78
South Carolina:						
Land rock	60,823	$308,968	$5.08	44,141	$367,209	$8.32
Tennessee:						
Brown rock	(a) 475,475	3,123,565	$6.57	$556,177	$4,425,761	$7.96
Blue rock	58,550	290,951	4.97	78,671	518,234	6.59
	(a) 534,025	$3,414,516	$6.39	634,848	$4,943,995	$7.79
Western States (b)	16,935	69,855	4.12	55,609	304,006	5.47
	2,271,983	$11,591,268	$5.10	$4,103,982	$25,079,572	$6.11

(a) Includes brown rock from Kentucky. (b) 1919: Idaho, Utah, and Wyoming; 1920: Idaho and Utah.

Drying Fine Concentrates

POSSIBLY the greatest evil of the flotation process, at least from the smelterman's point of view, is the production of an extremely fine, sticky, slimy concentrate, difficult alike to sample, transport, dry, and roast. In America this concentrate is ordinarily dewatered to possibly 50 per cent in a Dorr thickener and then further treated in an Oliver, Portland, or American filter to from 10 to 35 per cent of moisture, dependent upon the amount of slime present, a common figure being 18 per cent. This filter cake—a black sticky mud—is then shipped to the smelter in open cars; or, if the smelter is adjacent, conveyed by a belt conveyor.

Various methods are in use to get the filter cake out of the cars, in and out of the bins, and into the furnace. In some cases, further drying is attempted before roasting, but the problem has been a difficult one, and no machine for the purpose has been an unqualified success. Possibly the Lowden drier is the best so far offered. In this machine the concentrates are mechanically rabbled along over cast-iron plates heated from below. Recently, electrically heated driers have also received serious consideration. W. C. Clark, of the Bunker Hill & Sullivan Co., Kellogg, Idaho, prepared a paper on this subject for the Columbia Section of the A. I. M. E., and excerpts from Mr. Clark's paper may be of interest.

At the plant of the Hayes Milling Co., an extremely slimy concentrate was made, so that the filter cake was much wetter than usual. A 5 x 17-ft. Lowden drier of the grasshopper type, heated with an oil burner, was installed. An average of 175 dry tons was delivered per month, the feed carrying 35 per cent water, and the product averaging 14.96 per cent. The original weight of slimes treated was 218.7 tons, out of which 43.7 tons of water was removed. For heating the drier, $300 worth of crude oil was used (amount not stated), hence the cost for oil was $6.90 per ton of water extracted. Further expenses connected with this type of drying consist in the renewal of the hearth about every five months and renewal of the furnace lining about every three months, plus attendance and minor expenses.
three months, plus attendance and incidental minor expenses.

The Gold Hunter Mining Co. has installed an electric drier on top of an Oliver filter. This drier consists of eight coils of high-resistance wire, wound on one-inch iron pipe supports and placed one foot apart across the face of the filter. Each one of the eight heating units consumes 3.95 kw., or a total power input of 31.6 kw. The bonnet is heavily insulated with asbestos to prevent radiation, and the resistance wire is always kept at a red heat. This drier acts on all the product of the Oliver filter, or about thirty tons of mixed table and flotation concentrates in twenty-four hours. Before the electric heater was installed, the concentrates averaged 11 per cent moisture upon discharge, whereas with the heater in operation this moisture was reduced to 8.7 per cent, an additional 46 lb. of water per ton being thereby extracted. On the basis of thirty tons per day, out of which the drier takes 2.3 units, it appears that 1,380 lb. of water are evaporated per day. Electric current for the drier costs $4.74 per day, and the cost per ton of water extracted is $6.86.

The filter to which this electric heater has been applied was reduced in speed to give the cake a longer application of heat. This also had a tendency to increase the thickness, the cake with the drier operating being about one-half inch thick. The power consumption of this drier was measured on the 220-volt side of the transformers and across each coil separately; hence the actual consumption would be slightly over 31.6.

The Bunker Hill & Sullivan Co. has recently been experimenting on a new type of drier, which is expected to be serviceable and economical. The machine consists of a common iron pipe, 12 in. in diameter and 10 ft. long, set in a horizontal position for rotating, asbestos being wrapped around the pipe to a thickness of ⅜ in. Over the asbestos is wound 90 lb. of No. 4 bare, hard-drawn copper wire, making 205 turns. The ends of the wire terminate on collector rings provided to deliver current to the winding while the pipe slowly revolves. The winding carries 82 amperes at 282 volts and the heat is generated by eddy currents or hysteresis in the shell of the pipe, and is prevented from radiating by asbestos. The copper wire remains fairly cool.

This pipe is turned at a speed of about 7 r.p.m., and inside the pipe is a shaft provided with rabbles, which move the ore from one end to the other. The rabble blades extend to within ⅛ in. of the sides of the pipe. The rabble shaft turns at 1.36 r.p.m. and the whole apparatus is driven by a 2-hp. motor.

An air preheater is also provided to discharge hot air into the discharge end of the 12-in. pipe, where it is forced by means of a small fan through to the feed end, where another fan takes the moisture-laden air away.

The slime concentrates are transferred from the filter to a hopper at the feed end of the pipe by a belt conveyor. These concentrates contain 11.4 per cent of moisture as they leave the filter, and are dried to 6 per cent, which makes a product easily handled. The capacity of this machine is about 17 tons per 24 hours.

In a 48-hour test period, the machine consumed 1,220 kw.-hr., evaporated 2,686 lb. of water, and treated 46,766 lb. of wet feed, reducing the moisture from 11.4 to 6 per cent. The cost per ton of water evaporated was $5.66.

The rolling or trommel motion of the heated pipe, plus the action of the rabbles, causes the concentrates to form into balls, first as large as grapefruit; then, as the drying progresses, the blades cut up and push along the material, so that each ball is broken again and again, and the finished product consists of small pellets from ¼ to ⅜ in. in diameter, which are so hardened as to retain their form even after lying in the ore bins for several days. The dried concentrates flow from the ore bins like corn.

Experiments are under way to vary the capacity of this drier, one method consisting in providing means to raise or lower the discharge end of the 12-in. pipe. Among the difficulties which were encountered was the over-drying or dusting which takes place when the feed is interrupted. Also, if the filter discharges spasmodically, some material is produced which is not properly dried.

The method of producing heat in the shell of a pipe by means of the hysteresis and eddy current losses set up by a coil wound about the pipe has also been used in the Bunker Hill lead refinery and for heating the pulp feed to an Oliver filter. From experiments which were conducted, it was found that a 4-in. pipe 6 ft. long, filled with cold lead, could be melted out in a few minutes; also, that wrought-iron or steel pipe was preferable to cast-iron pipe. Application has been made for patents to cover the application of this electrical phenomenon for the purposes mentioned.

BY THE WAY

Farming the Abandoned Mine

Don't throw away the old and abandoned mine! Turn it into a mushroom farm. When hope seems faltering and prospects dark a new use for the old workings appears. The New York *Sun* of May 11 records the fact that the old Schuyler copper mine at Arlington, N. J., which produced the copper from which were minted the first United States pennies, has been cleaned out and the 65 and 100 levels planted with mushroom spawn on suitably prepared beds. Eureka! A new use for hot ill-ventilated stopes, drifts, adits and tunnels. The heat from the bosom of old Mother Earth will start a vigorous germination and electric light will substitute for Old Sol. Immunity from depredations, neighbors' chickens, sudden frost and excessive drought is assured, and an eager market awaits. Most miners know that fungi will grow in a mine. Why not encourage the edible variety to do business on a commercial scale? Even the mill classifiers may come in handy—and the jigs. Truly, a hole in the ground is not necessarily a mine; it may be a truck farm. Why not raise gold fish, or silver fish—or suckers—in the flooded parts?

Modest Requirements

"W'en I wuz in Leadville years h'ago, m'son," said Cap'n Dick, "there wuz a chap, Billy Trembath, 'oo wuz a brave h'eater an' wuz most 'andy at tha boardin'-'ouse table. W'en Billy wuz night shif' sometimes 'ee would go daown town in the moornin' an' would'nt get back till time to go on shif' again. One day I said to 'im, 'Billy,' sez I. 'don't 'ee get 'ungry goin' daown town an' stayin' h'all day like that?' 'No,' sez Billy, 'not w'ot you'd call 'ungry, but sometimes I feels like 'avin' a bite. Then I gaws to tha bake-shop an' get a loaf o' rye bread, an' at tha butchers I get a paoun', paoun' an' a 'alf o' sausage. H'after that I gaws to the stoor an' get a paoun,' paoun' an' a 'alf o' cheese, an' a gert red h'onion, w'ich with a 'alf a gallon o' beer at tha Pick an' Dag saloon makes h'as pretty a lunch h'as a man could wish for.'"

Oregon's Gold Bonanza

Romance, gold, blind luck, and a gambling chance are combined in the story of the Boswell mine, in Josephine County, Ore. The mine, an important discovery, is on the ancient stamping ground of the argonauts and prospectors. A man named Anderson prospected the ground, near Holland, seven miles north of the California line. He found some gold and traced it up the mountainside for quite a distance, but finally lost it. He staked out a claim and took in as partner "Dry Wash" Wilson, and it is reported that they recovered about $300,000 from the claim. Anderson wrote his old friend Boswell in Montana, inviting him to come to Josephine County, as "it's a nice looking country." Boswell, arriving, asked him where he should stake a claim. "Anywhere," said Anderson. Boswell staked out the claim adjoining Anderson's.

It was within twenty feet of Anderson's line that Boswell made the strike. He and his boy did a little mining by hand. They were making up about $6,000 in gold one day, when two masked and armed men held them up, bound the pair and disappeared with the gold. Later, the two took about $50,000 from the mine, when the son was drafted into the army. The father promised that he would not work the property until the boy returned. Young Boswell went over seas and lost his life on the front. The elder man, refusing to consider that death cancelled the promise, kept the mine closed. Recently he let it be understood that, though he would not work the mine, he would sell it for $100,000.

The first nine days that the new owners operated the property they recovered $30,000 in gold. At 20 ft. in depth the vein showed 12 in. of high-grade and 23 in. of quartz running $125 per ton. At 30 ft. there was a 16-in. strip of high-grade and four feet of quartz running better than $125 per ton; or, so it is reported.

Calling a Spade a Spade

"Dids't ever 'ear tell o' Mrs. Tregoning, 'oo ran tha boordin' 'ouse to tha Green 'Ill mine?" said Cap'n Dick as the mine volunteer fire department was coiling up the hose after putting out a small blaze that started in a shed behind the blacksmith shop. "Well, m'son, she wuz a fine woman an' 'ad a good boordin' 'ouse. One day she gaws daown to the company store an' bought a pair o' stockin's. At tha h'end o' tha month h'in comes tha bill, an' they 'ad charged one pair o' 'ose, fifty cents. So she put on 'er bonnet an' went h'over to tha stoor. ''Ere,' she sez to Billy Smith, tha 'ead clerk, 'W'at's thee mean with chargin' me h'up with this 'ere 'ose? Never got no 'ose any'ow, an' isn't goin' to pay for un, nuther. W'at do I want with a 'ose? Got nothin' but two by four garden, an' I waters un with a 'and bucket.'"

The Gold Miner

Written for *Engineering and Mining Journal*

A bard there sat on Market Street
And twanged a twanging lyre;
In wavering tones his trembling voice
Mounted higher 'n higher!

* * * * * * *

A miner bold once found some gold
Outcropping in a ledge;
A crosscut long he drove like mad,
A-pounding steel with sledge.

And when he felt he had enough
Of ore reserves blocked out,
Sold some stock to equip the mine;
Success he could not doubt.

The plant complete, ready to treat
The ore reserves galore,
Came stalking through the land one day
Old Mars, the God of War.

With leering look, he sat him down
And called the miner bold,
And said, "My lad, let's deal the cards
I'll play you for your gold."

And when at last the game did end
The miner looked around;
His ore was gone! His plant was scrap!
His mine a hole in ground!

He tore his hair and ground his teeth,
And raved and cursed and swore,
And knew too late he'd been unwise
To buck the God of War.

And Mars looked on with heartless gaze,
His face was cold and grim,
For ages past he'd broken men
Who dared match wits with him.

HANDY KNOWLEDGE

Milling Details

BY W. R. CANTON

Written for *Engineering and Mining Journal*

A Launder Classifier

In the course of working out a concentration system, there arose the need for a fairly close classification. There was not room enough to install a manufactured classifier, and it appeared that the solution of the problem lay in a launder classifier. It was to meet this need that the classifier shown in Fig. 1 was devised. It is constructed of materials easily accessible around a large plant and is inexpensive. The outside is of 6-in. pipe, and the feed inlet is of 3-in. pipe, to which is welded the top of ¼-in. plate. A 1½-in. pipe brings in the hydraulic water on a tangential line. The bottom is formed by a bell reducer reducing from 6 in. to 3 in. Into this is screwed a 3 to 1½-in. flat reducer. A 1½-in. pipe forms the discharge which carries away the sands.

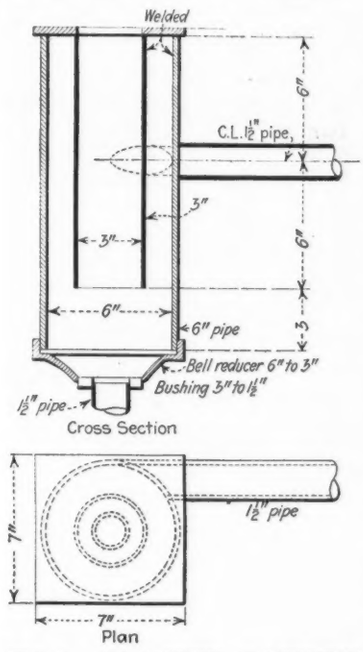


FIG. 1. A LAUNDER CLASSIFIER

Fig. 2 is a sketch to scale showing the installation. This classifier has given efficient service in making a separation at 40 mesh, and will give good results over a range from 6 long tons to 13.6 long tons per hour. Nine months' use has shown no appreciable wear except that of the discharge spouts.

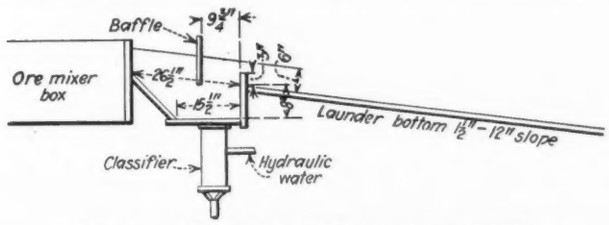


FIG. 2. LAUNDER CLASSIFIER INSTALLED

An Ore Wetter

Often the need arises for an efficient method of wetting an ore. It was to meet this need with a simple appliance that the ore wetter shown in Fig. 3 was designed. The water flushes over the top plate upon which the ore drops in such a way that the ore is always falling on a sheet of water. The top plate is made larger than the others so that it may be reversed when worn. This installation has given good results in practice, handling as much as 13.5 long tons per hour.

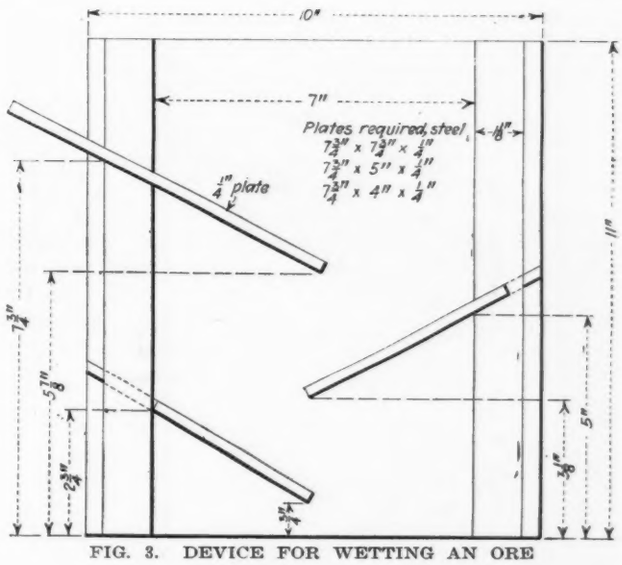


FIG. 3. DEVICE FOR WETTING AN ORE

An Ore Gate

A detail drawing for an ore discharge gate is shown in Fig. 4. Instead of the 6-in. pipe discharge shown, a bell reducer followed by a bushing with any desired opening may be used. The apparatus is bolted to the bottom of the bin and attached to the 6-in. drop pipe by a 6-in. flange. The only wearing part is the discharge bushing. This gate will give a steady flow of material.

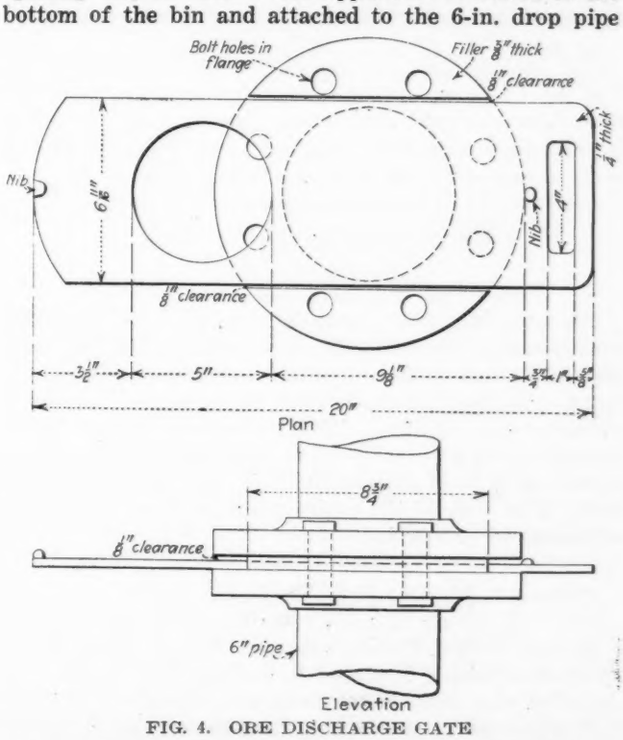
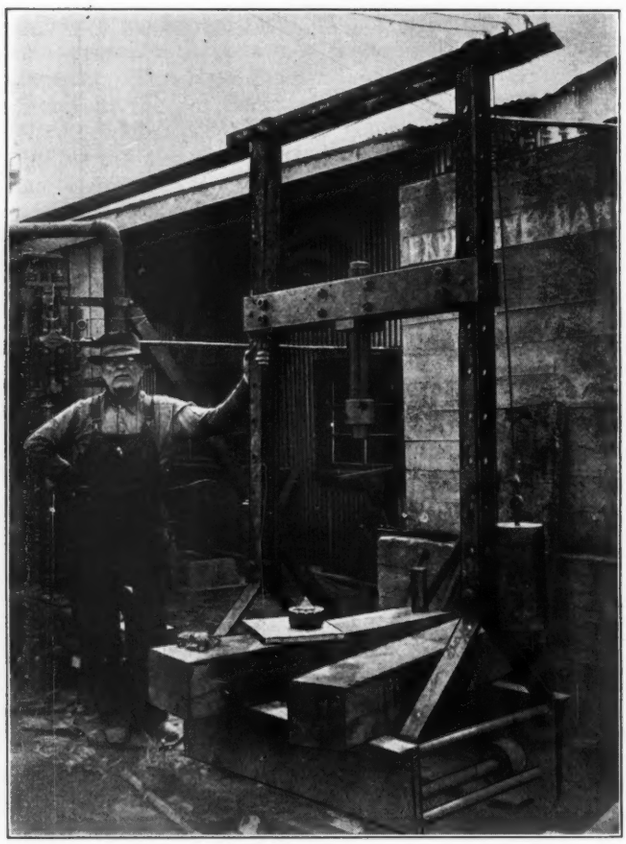


FIG. 4. ORE DISCHARGE GATE

A Screw Press

Written for *Engineering and Mining Journal*

A simple and practical screw press that serves a number of useful purposes about the mine shop is shown in the accompanying photograph. It was made by Andrew Riley, master mechanic of the Plymouth mine, Plymouth, Cal. The tension members are attached to



A HOME-MADE SCREW PRESS FOR SHOP WORK

two short lengths of channel iron which form the body of a four-wheeled truck. The crosshead is supported by cast-iron counterweights, and can be adjusted for vertical height within a range of approximately 7 ft.

Estimating Irregular Areas

By Sam Soddy

Written for *Engineering and Mining Journal*

The area of a plan drawn to scale may be estimated approximately by determining its weight. To do this cut out from a thin sheet of zinc or any other suitable metal or homogeneous material the outline of the plan whose area is desired. Weigh this accurately. Then cut out a large square section from the middle, weigh it, and as it is of regular form it can easily be measured. The area of the entire plan can then readily be calculated by proportion.

Handy Fire Extinguishers

Written for *Engineering and Mining Journal*

At the Central Eureka mine, at Sutter Creek, Cal., a fire extinguisher is placed in a convenient position in the midst of a group of compressors and other machines. It is supported at such a height as to be readily visible from almost all points in the building. In placing such extinguishers, careful study of the fire risk should be made and the extinguishers should be easily within reach.

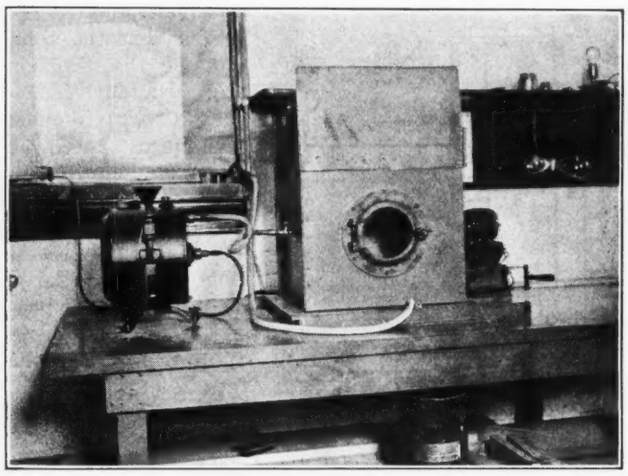
Gas Box for Safety Lamps

By Walter S. Weeks

Written for *Engineering and Mining Journal*

A piece of apparatus necessary for a mining laboratory is some sort of box into which gas may be introduced so that the flame caps on safety lamps may be observed. The accompanying illustration shows such a box, which I had made for the laboratory in the University of California. The box is cubical and is made of galvanized iron which is .048 in. thick. It holds two cubic feet. The glass observation door is a ship's port light 6 in. in diameter. This is bolted on and soldered.

A safety valve to relieve the pressure in case of an explosion is necessary. This is made by placing in the



GAS BOX FOR OBSERVING FLAME CAPS ON SAFETY LAMPS

top of the box another port light, from which the glass has been removed. A piece of bond paper can be placed over the hole and clamped tightly by the door. If the door of the port light enters the hole far enough to tear the paper it should be ground off.

At the right in the illustration is shown a small motor which turns a shaft which enters the box through a stuffing box. On the shaft inside of the box is a small disk fan. This fan mixes the gas and air.

At the left is an "American" wet test-meter. One revolution of the arrow on the dial indicates one-tenth of a cubic foot. Gas is passed from a tank through a reducing valve through the meter and into the box as shown.

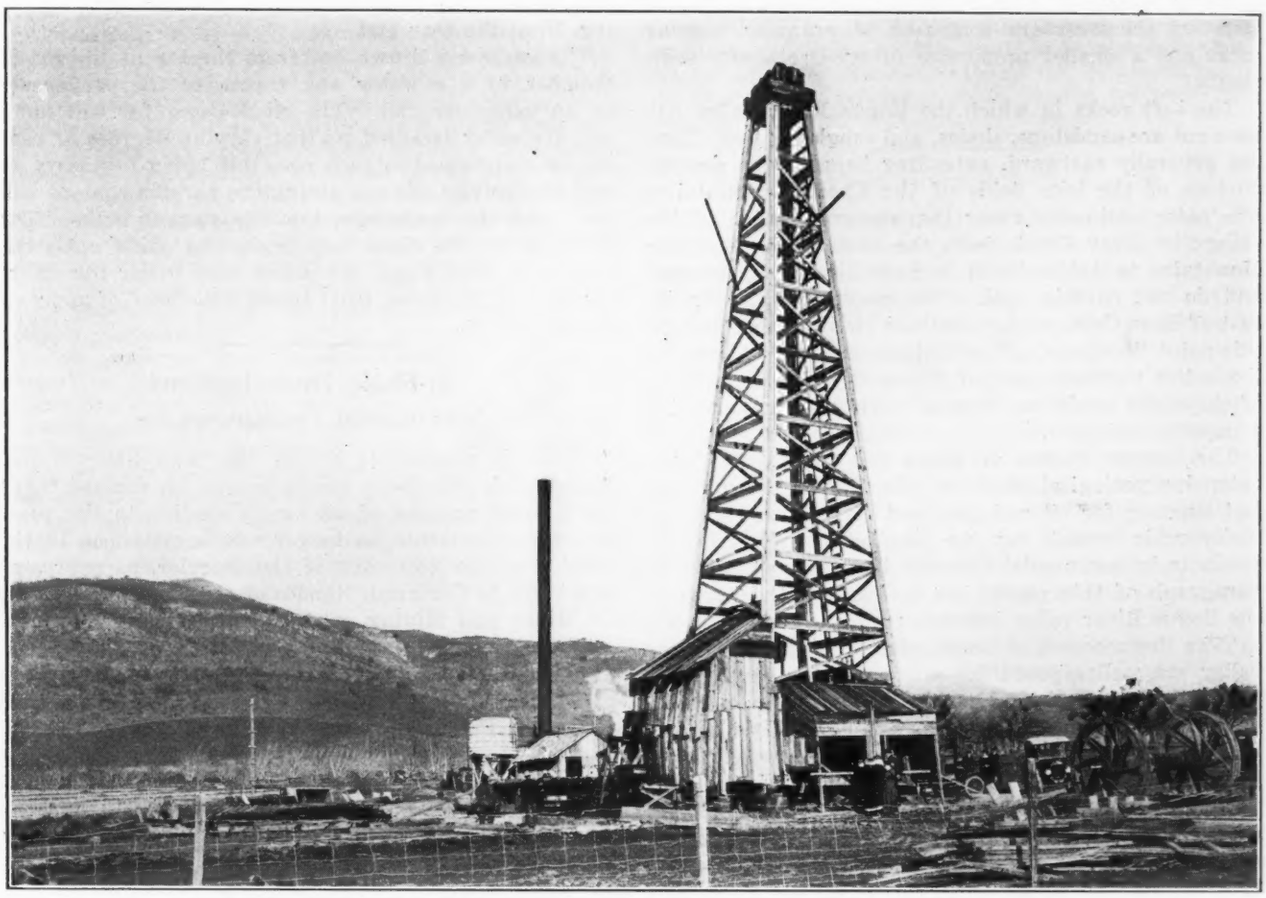
The safety lamp is placed in the box. The desired amount of gas is introduced and mixed with the air by the fan. The flame caps may then be observed. If methane or natural gas cannot be obtained, acetylene makes a good substitute for demonstrating the principles.

A small hose connected to a compressed-air line should be at hand for cleaning the box after a test. The shield in front is to protect the observer from an explosion.

A black cloth, such as photographers use, should be fastened to the front of the box to shut out the light. A piece of black cloth should be laid on the explosion door to exclude light.

A few years ago methane was encountered in a tunnel in Berkeley, Cal. Several men were killed by an explosion. It became necessary to work in the tunnel under rules such as prevail in gaseous coal mines. We were obliged to educate the whole crew in a subject of which they had never heard. This gas box proved most useful in the work of instruction.

THE PETROLEUM INDUSTRY



THE TRIGONIA OIL WELL WHICH IS BEING DRILLED IN ROGUE RIVER VALLEY, OREGON, SHOWING SANDSTONE BLUFFS CAPPED WITH BASALT LAVA IN THE FOOTHILLS OF THE CASCADE MOUNTAINS ON THE EAST

Oil Developments in Rogue River Valley, Oregon

BY A. E. KELLOGG
Written for *Engineering and Mining Journal*

ALTHOUGH nothing of spectacular nature is evident, there is steady activity and increasing interest in oil exploration in the Rogue River valley, southern Oregon. Three companies having extensive leases, locally financed and actively engaged in drilling for oil in the valley, are the Trigonia Oil Co., the Vulcan Oil & Gas Co., and the J. F. Munday Co. All of these have headquarters at Medford, Ore. The Trigonia Co. has made the greatest development since operations generally begun last summer.

The Trigonia well has reached a depth of over 1,000 ft. at a cost of $50,000, which includes equipment and a large supply of casing for an additional well. This amount has been furnished by the business men of Medford, and they have guaranteed further funds to go to a depth of 2,100 ft., which the engineer in charge, E. W. Liljegran, of Medford, Ore., estimates will bring results.

The log of the well down to 695 ft. shows that black and gray lime shale predominated and gave a paraffin residuum. Water strata with a heavy flow was struck at 50 ft. and 150 ft. Indications of gas appeared at 125 ft. At 695 ft. the black and gray lime shales were mixed with silica sand, and down to 800 ft. the limestone changed in color to gray, green, and red, accompanied with silica sands. At 800 ft. gray and black sand appeared, with a flow of water, and some indications of gas, and continued to 822 ft., to which point the well is cased with 12-in. casing from a depth of 241 ft., where 16-in. casing is used. Drilling from this point is continued with an open hole and passes through a hard formation of limestone, cut with thin strata of gypsum and asphaltum, showing indications of gas, and giving an increased paraffin residuum. The recent drilling gives more pronounced asphaltum beds.

The oil prospects in the valley are closely associated with its coal deposits, which occur at numerous places. The valley is situated between the Cascade Mountains on the east and the Siskiyou Mountains on the west. The

coal belt is long and narrow, and begins in the Umpaqua Mountains north of the valley, stretches to the south and southeast through Sams Valley into the valley east of Medford and Ashland, and continues through the Siskiyou Mountains into California, a total distance of 100 miles.

The Cascade Mountains, east of the coal belt, are made up mainly of Tertiary lavas; the Siskiyou Mountains on the west are composed of granular igneous rocks and a smaller proportion of pre-Cretaceous sediments.

The soft rocks in which the Rogue River valley has been cut are sandstone, shales, and conglomerates. They dip generally eastward, extending beneath the greater portion of the lava fields of the Cascade Mountains. The older sediments along the western portion of the valley, by Bear Creek from the foot of the Siskiyou Mountains to Ashland and Jacksonville, are Cretaceous and do not contain coal. The coal-bearing rocks lie east of Bear Creek as far north as Medford, but beyond this point they overlap the Cretaceous rocks and occupy the entire northern part of Rogue River valley. Tests of shale and sandstone from all over this territory give a paraffin residuum.

The Oregon Bureau of Mines and Geology made an extensive geological study of the Rogue River valley last summer for oil and gas, and last winter made an unfavorable report for the production of petroleum products in commercial amounts in the valley. A final paragraph of this report has not dashed the hopes of the Rogue River valley interests:

"The Cretaceous and Eocene deposits of Rogue River valley are well exposed for study, and all through its entire thickness offer no horizons favorable as a source of commercial quantities of petroleum. This region, with its gentle monoclinal structure and its open plunging anticlines, should show innumerable indications of petroleum if such ever had existed in any quantity in the valley. This region is such an open one and so easily studied that a careful examination is conclusive that it offers no favorable territory for the production of petroleum products in commercial amounts."

This report is confirmed by local geologists, who claim that seismic disturbance in the past had in all probability so broken up the underlying strata as to permit the escape of whatever oil might have been stored in the valley. This is controverted by oil men, who point out that the shale, coal, and sandstone were undisturbed when the mountains were formed, that the sandstone anticlinals are still intact, and that the stone is of a coarse-grained variety, which is considered favorable.

Oil-Shale Company Starts Reduction Plant

SPECIAL CORRESPONDENCE

The Monarch Oil Shale Co. has begun the operation of a reduction plant near De Beque, Col. The initial operation of the plant shows a capacity of over 60 bbl. of oil every twenty-four hours, and with suggested improvements, the management states, it will soon be brought up to 100 bbl. daily. Tankage capacity at the plant is exhausted, and arrangements are now being made for trackage and tank cars to bring the product to Boulder, where it will be refined by the Apex company. It is claimed that the shale oil yields a much higher grade of gasoline, kerosene, and lubricating oils than natural oil from wells.

The shale is ground to one-half-inch mesh, and automatically fed to the retort. The Ginet retort is horizontal, 25 x 3 ft., and set in firebrick. The shale is advanced from the front to the rear of the retort bottom by revolving agitating shovels, and the spent shale is discharged automatically. The retort is heated by combination oil and gas burners, the most efficient heat considered to be from 550 deg. F. at the front to 770 deg. F. at the rear end.

The gases are drawn out from the top of the retort chamber to a collector and thence to the condensers by an exhauster fan. The condensers, four in number, are water-jacketed, so that varying degrees of heat can be maintained in each one, this being necessary so that the heavier oils containing the paraffin content will flow from the condensers into the storage tanks. The gases, from the time they leave the shale until the remaining fixed gases are finally used under the retort for heating the same, must travel a distance of approximately 250 ft.

Oil-Shale Investigations

WASHINGTON CORRESPONDENCE

Oil shale constitutes by far the most likely source from which petroleum products may be derived when our present sources of oil supply decline to the point where requirements no longer can be satisfied, in the opinion of the Secretary of the Interior, as expressed in a letter to Chairman Rhodes of the House Committee on Mines and Mining, who had asked for his conclusions in regard to pending legislation providing that $140,000 shall be made available to the U. S. Bureau of Mines for investigating oil shale. Extracts from Secretary Fall's letter are as follows:

An adequate national supply of petroleum is essential to assure prosperity to the United States of America. The U. S. Geological Survey estimates that we have produced 40 per cent of the oil recoverable under present operating methods, which leaves only 60 per cent to be recovered for all the future. . . .

A great many reports have been received recently from Mexico which indicate that the present producing fields soon will seriously decline in production. The oil fields so far developed in Mexico are exceptional in that the individual wells are such large producers. Many of these large wells have recently turned from producing oil to producing salt water. There are, of course, other undeveloped fields in Mexico, but it is not at all certain that they will yield as much oil as is being produced by the present wells.

As the United States cannot depend on its own oil fields to produce all the oil it needs, and with the probability of decreasing imports from Mexico within the next few years, it is time for this Government to give serious attention to possible future petroleum substitutes.

The most likely substitute for our present crude oil is to extract the oil from our oil-shale rock, by distillation. The potential supply from this source far exceeds in quantity all proposed oil substitutes from vegetable and other non-mineral sources. The U. S. Geological Survey estimates that there are in the oil shales of Colorado, Utah, Neavda, and Wyoming about 60,000,000,000 bbl. of oil, an amount many times the possible oil to be recovered from our oil fields.

To recover this oil from the shale at a profit is no simple problem. Before it can hope to be a commercial success, many fundamental technical problems must be solved. Up to the present, efforts to establish the oil-shale industry on a commercial footing have been unsuccessful, largely because of the lack of this fundamental information, and undoubtedly much money is being wasted. The important problem is to produce from the shale an oil which can be refined into gasoline and other products without a great

loss. (The Scotch shale-oil industry has been established for over fifty years, and even today the refining loss is almost 25 per cent.) . . .

The oil-shale industry will eventually be developed into one of the large industries in the United States. This, however, will be a matter of many years; first, on account of the great amount of technical knowledge and practical experience which must be obtained, and, second, on account of the large amount of capital which will be necessary for development on a commercial scale and which will be available only as the price obtained for the products justifies the expenditure. Unless fundamental investigations are started, the development of the oil-shale industry will be delayed, and as the need for the oil becomes pressing, large installations will be made hastily. It is a safe prediction that if these are erected without sufficient fundamental knowledge, much avoidable waste will result. If the Bureau can within three years place at the disposal of the many companies and the public interested in oil shales the basic facts on which the commercial industry can be built, the investigation will justify itself many times over.

During the last two years the Bureau of Mines has spent about $8,000 per annum from the regular petroleum and natural gas allotment in order to carry on work in the oil-shale industry. In addition, this sum has been supplemented by an appropriation of $10,000 from the State of Colorado and $10,000 from the State of Utah, which has been expended under Bureau supervision. Even with this small appropriation, the Bureau has been able to work out a few of the problems in the laboratory, with results which will ultimately save American business large sums of money.

There are 4,000,000 acres of private and public land subject to leasing for oil shale. When the industry is developed, the Government can expect a return from royalties which will far exceed the appropriations asked for the investigative work.

The Director of the Bureau of Mines has advised Secretary Fall that the following investigations in regard to oil shale should be carried to completion:

1. What is the best kind of process for recovering the greatest amount of oil of the best quality at the lowest cost?
2. How should shale oil be refined? (Shale oil differs materially from ordinary petroleum and requires special refining methods. In Scotland the refining loss is 25 per cent. It is imperative that this refining loss be reduced, in order to make the industry profitable.)
3. How may ammonia and other byproducts be recovered from shale, and under what conditions can they be made profitable?
4. What are the best methods of mining shales, in accordance with their occurrence?

Further outlining the needs of oil-shale research, the director of the Bureau of Mines says:

In order to supply the fundamental engineering data to cover these points, the Bureau of Mines contemplates, under the appropriation of $140,000 requested, to extend its laboratory investigations and experiments, to start semi-commercial investigations and experiments, and to co-ordinate the investigations now being made by various states, universities, companies, and individuals, compiling and making available all possible information on the subject of oil shales to those interested and to the general public. The Bureau of Mines contemplates the establishment of an oil-shale station at a suitable locality, including the necessary grounds, laboratories, and equipment. It also contemplates the acquisition of a small tract of suitable shale land, to be set aside as a permanent standard of oil shale for comparative purposes, now and in the future. The Bureau would erect a one-unit Scotch retort, the design and the operation of which are well understood, to provide a means of comparing one retort against another and one shale with another and with the Scotch industry. By means of the completed retort and a standard shale it will be possible to compare various processes one with another, various methods of retorting one with another, and various shales one with another. These comparisons will be invaluable to the industry and can be done only by a Federal agency.

It is expected that the Bureau of Mines will receive the hearty assistance and co-operation of various states and institutions and that it will be possible in this way to considerably increase the amount of work done. The Bureau does not contemplate commercial operations; first, because the necessary fundamental engineering data are not yet available, and, second, because to make a commercial demonstration adequate, it would have to be carried on for a sufficient time to provide cost data, develop markets, and establish labor sources. This would be an elaborate undertaking, and it is felt that it should not be undertaken by the Government, because it would conflict too much with commercial developments.

Auction of Wyoming Oil Lands

The Department of the Interior has announced the sale at public auction, under Section 17 of the oil-leasing act, of 6,480 acres of land in the Salt Creek oil field of Wyoming. The sale will be held at the United States Land Office at Douglas, Wyo., on June 15. The lands have been divided into blocks of 160 acres each and consist of sixteen "inside" tracts in the highly productive area and twenty-five "edge" tracts, each having an approximately equal value. The tracts will be sold to the bidder who offers the largest bonus. No one person, association, or corporation may purchase more than 640 acres. A base royalty of 33⅓ per cent on the oil produced is fixed on the "inside" tracts, and of 25 per cent on the "edge" tracts. The base royalty on gas is the standard royalty fixed by the Secretary of the Interior on Dec. 20, 1920.

One-fifth of the bonus must be deposited in cash or certified check by the successful bidder on the day of the sale, and the remaining four-fifths must be paid in four equal quarterly installments, subject to the condition that the successful bidder deposit bank certificates of deposit, Liberty bonds, or corporate surety bond in the amount of the deferred payments.

Under the terms of the leasing act the United States Reclamation Fund receives 52½ per cent of all bonuses and royalties paid under this sale, and the State of Wyoming will receive 37½ per cent of them for use on public roads and in education.

A map showing the Salt Creek oil field and the blocks to be leased may be obtained from the General Land Office, Washington, D. C.

Notes From the Salt Creek Field

SPECIAL CORRESPONDENCE

The Midwest Refining Co. has secured full title to a lease on Sec. 26-40-79 in the Salt Creek oil field, Wyo., as the last remaining counter claim, that of Lee Stock, has been thrown out by the Department of the Interior. The New York Oil Co. will also be benefited by this decision, as it holds a royalty on 480 acres in this section. Sec. 26 is believed to be the richest section in the Salt Creek field, and now that the title is cleared it is expected that a large production will be developed.

On May 11 the Midwest Refining Co. paid to the State of Wyoming the sum of $162,338, which was the value of the state's 10 per cent share of the oil production from the Ridgeley lease in the Salt Creek field. The money had been impounded for a number of years pending a decision by the Government on the title to this land. The Ridgeley syndicate of twelve shares will receive approximately $35,000 per share.

ECHOES FROM THE FRATERNITY

SOCIETIES, ADDRESSES, AND REPORTS

Bradley Stoughton Resigns as A. I. M. E. Secretary

Relinquishes Office After a Notable Record of Successful Achievement In Promoting Growth and Prestige of the Institute

The resignation of Bradley Stoughton as secretary of the American Institute of Mining and Metallurgical Engineers will come as a surprise to many of the members. Mr. Stoughton has been the secretary since 1913, and during his incumbency has rendered signal service to the Institute. As some indication of the advances that have been made in the past eight years the following comparison is of interest:

The paying membership has grown from about 3,500 in 1912 until it now exceeds 9,000. At the same time the number of local sections has increased from four to twenty-six at the date of writing, and a number of additional sections are being formed.

Technical committees to the number of eighteen now cover every department of the Institute's activities, including industrial relations. Up to and including 1912 the Iron and Steel Committee was the only one of this kind fostered by the society. At that time, also, there was no regular employment department, a branch which has now grown to large volume and importance to the profession.

As to the publications of the Institute, in 1912 and previously the *Transactions* per year averaged one volume; from 1914 to 1921 inclusive the yearly average has been three; while the monthly magazine has about quadrupled in size during that interval.

The increasing interest on the part of members is partly reflected in the growing attendance at meetings, from 220 to over 1,100; and the increased membership and activities has entailed a growth in the annual budgets of receipts and expenses from $55,000 in 1912 to an estimated volume of $203,000 receipts and $198,000 expenses in 1921.

There was no activity in public affairs in Institute life in the year 1912 or previously. At present this department of the Institute's work includes, besides its representation and financial support of American Engineering Council, committees on mine taxation, on coal stabilization, support of the Naval Consulting Board, the National Research Council, and the American Engineering Standards Committee.

There were twenty-two affiliated student societies in 1912, but they had little connection with the Institute, and the mutual exchange of advantages was slight. In 1921 there are thirty-seven affiliated student societies in most active communication with the Institute, through correspondence, publication of meetings in the monthly magazine, and on visits and addresses of the President and Secretary. In this way the younger men of the profession are connected at an early date with the national society of mining and metallurgy.

Secretary Stoughton's letter follows:

May 17, 1921.

To the Members of the Board of Directors of the American Institute of Mining and Metallurgical Engineers, 29 West 39th Street, New York City.

Gentlemen:

About two years ago, I indicated to the president and some members of the board my belief that the office of secretary of

BRADLEY STOUGHTON

the Institute should not be a permanent one. It is my observation of events, not only in our own Institute, but also in several sister societies, that too long a tenure of office by the secretary inevitably leads to a situation which is not good either for him or for the society. After submitting this in writing to the directors on Feb. 17, 1920, I was overpersuaded by members of the board to defer resignation until a more convenient time for the Institute. The action of the directors on Feb. 15, 1921, electing me as secretary, "The engagement to be terminated at the pleasure of either party," was satisfactory to me, because it made it possible to tender my resignation when it became convenient for the board to elect my successor. As this time has arrived, I tender my resignation herewith.

I assumed the office in 1913 at a loss of several thousand dollars per year income. Nevertheless, the termination of my very agreeable duties as secretary is attended with much regret on my part. I have formed the most pleasant relations, and many friendships, with officers, directors and members of the Institute. To all of these friends, and to all members of the Institute, I wish to express my sincere appreciation of the support and co-operation that have been rendered me.

I ask that my resignation be accepted at the convenience of the board. I am willing, however, to remain in the service of the Institute for a reasonable time, to assist my successor in familiarizing himself with the details of the work and the matters of routine.

Yours respectfully,
BRADLEY STOUGHTON,
Secretary.

The Board of Directors of the Institute accepted with regret the resignation of Mr. Stoughton as secretary, and put upon record its appreciation of his long and efficient service to the Institute as well as of his willingness to postpone an actual severance of relations until it may be convenient for the board to elect a successor, and even until such successor shall have had an opportunity of becoming acquainted with the details and routine of the office.

The board recognized the fact that the duties of the office of secretary have been greatly increased since Mr. Stoughton accepted office eight years ago. The board also expressed its appreciation of the fact that while Mr. Stoughton's predecessors were not frequently called upon to travel except when meetings were held outside of New York City, under the policy introduced some years ago of visiting the local sections or having the Institute adequately represented at the meetings of other scientific bodies, Mr. Stoughton has been called on to travel. The board was convinced that in his bearing and in his speeches he had worthily represented the Institute and had enhanced its appreciation among the many members who are not able to visit New York headquarters frequently.

The Board of Directors also expressed the hope that in a new field of activity Mr. Stoughton may have the great success which his abilities deserve, and put on record its appreciation of the self-sacrifice with which he had devoted himself to the interests of the Institute at the expense of his own professional preferment and financial advantage.

State Department Extends Courtesies to M. and M. S. A. Members Working Abroad

Members of the Mining and Metallurgical Society of America who contemplate traveling abroad on professional business in behalf of American interests can avoid the annoyance of finding themselves without satisfactory introductions, by communicating with the secretary of their society, F. F. Sharpless, 115 Broadway, New York City.

Arrangements have been perfected whereby the consular and diplomatic representatives of the United States in the districts to which the engineer is going will be advised concerning his pending visit. It is anticipated that the arrangement will prove of mutual benefit.

Mitke Leads Discussion on Mine Fires for Boston Section

The sixty-eighth meeting of the Boston Section of the A. I. M. E. was held at the Engineers' Club at Boston, Mass., on Monday, May 9, with thirty-seven members and guests present. W. Spencer Hutchinson, chairman, presided. Edwin Ludlow, president of the Institute, gave an interesting account of his recent visit, in company with Secretary Stoughton, to some of the other sections. He then turned to the work being done by Mr. Hoover and the American Engineering Council and the part now being taken in national affairs by engineers. Mr. Ludlow expressed the hope that these activities would not cease, now that the war is over, but would increase still further. He is of the opinion that the engineering profession can render particularly valuable assistance to the country by combating bolshevist tendencies and supplying the country with information, so that the weight of public opinion may be thrown on the side of justice rather than on the side which, through better organization, frequently has caused the public the most discomfort.

Bradley Stoughton followed Mr. Ludlow, adding to his description of their Western trip. Mr. Stoughton also discussed the necessity for concerted action by the engineering profession. He described the development of class consciousness by labor and capital and the failure of the brain workers to develop it to the same extent and the consequent difficulty the latter experience in securing a hearing. To correct this condition he urged united effort and strong support of the movements to link the engineering societies and organizations.

The chairman next introduced Charles A. Mitke, who spoke on "Fires in Metal Mines." His talk covered the causes of mine fires, the methods of preventing and extinguishing them, and the trouble and expense they involve. Mr. Mitke also called attention to the importance of considering the fire hazard when selecting a mining method.

Some discussion followed as to whether chalcocite or pyritic ores are the more dangerous, and whether it is oxidation or friction that is responsible for the greater part of the heat generated. Mr. Ludlow related some of his experiences with mine fires in the anthracite coal fields of Pennsylvania.

Columbia School of Mines Improves Ore-Dressing Plant

The Miami Copper Co. has given the Columbia University School of Mines $2,500 for the purchase and installation of new equipment for the school's ore-dressing laboratories. A like amount has been given by Arthur S. Dwight, and important loans of machinery have been made by the Dorr company and the Hardinge company. These reinforcements, together with much remodeling and rearrangement of other appliances, including some eliminations of out-of-date pieces, bring the laboratories at Broadway and 116th St. up to present-day needs for instruction, research, and effective cooperation with the mining and milling industries.

The generous attitude of many company officials toward the engineering schools is further evidenced by these gifts and loans. According to Prof. A. F. Taggart, of the Columbia School of Mines, one of the aims of the Miami Copper Co. in transferring the above fund to that school is to insure the maintenance in New York City of a modern, well-equipped laboratory for the study of problems in the treatment of ores.

Washington College of Mines Seeks Students of Metallurgical Problems

The College of Mines of the University of Washington offers four fellowships in co-operative work with the Northwest Experiment Station of the U. S. Bureau of Mines at Seattle, Wash. They are open to properly qualified graduates of universities and technical schools, and have a value of $900 per year of twelve months, beginning July 1. Their purpose is to undertake the solution of problems of special importance to the Pacific Northwest and to Alaska, and the incumbents will be assigned chiefly to laboratory work under the experiment station technologists. The subjects for 1921-22 are: Beneficiation of coal, especially by washing; electrometallurgy; ceramics; and the survey of the clay resources of the Northwest.

Applications, accompanied by copies of collegiate records, professional experience, and three personal references, should be addressed before June 1 to The Dean, College of Mines, Seattle, Wash.

Kansas University Celebrates Founding of Its Engineering School

The thirtieth anniversary of the organization of the School of Engineering at the University of Kansas was celebrated on April 19 and 20 with a "Conference on Engineering Activities in Kansas" by visiting engineers, and with an elaborate "Engineers' Day" program by the students.

In the conference on engineering activities Prof. C. M. Young made a special report on Kansas coals, and State Geologist Raymond C. Moore spoke on oil and gas. It was generally agreed that the most helpful line of research open to the engineering department of the university is the study of the deterioration of materials and structures as the result of exposure to the weather. Major-General William M. Black, chief engineer, U. S. A., retired, spoke on the education of engineers.

A. I. M. E. Members Form a Philadelphia Section

Forty members residing in or within fifty miles of Philadelphia met at the Engineers' Club in Philadelphia on the evening of May 16, the semi-centennial of the founding of the Institute at Wilkes-Barre, Pa., on May 16, 1871, and organized the Philadelphia Section of the Institute.

There were present two of the three surviving founder members of the original body, Willard P. Ward and Dr. Henry S. Drinker. E. C. Pechin, the third, expressed in a letter much regret at not being able to attend.

The organization of the section had been duly authorized by the board of directors, following a petition signed and presented by twenty-nine local members. By-laws were adopted, and an organization was effected by the election of an executive committee composed of Guillaem Aertsen, H. M. Chance, G. H. Clamer, Henry S. Drinker, F. Lynwood Garrison, E. W. Parker, A. A. Stevenson, L. H. Taylor, Jr., S. D. Warriner, and Morris Williams. This committee elected the following as officers for the first year: Chairman, Dr. Henry S. Drinker; vice-chairmen, H. M. Chance, A. A. Stevenson, S. D. Warriner; secretary-Treasurer, F. Lynwood Garrison, 982 Drexel Building, Philadelphia. Mr. Ward was elected an honorary member of the Philadelphia Section.

Dr. Drinker gave a condensed résumé of the founding and early days of the Institute, and his address was followed by some interesting reminiscences by Mr. Ward.

A general discussion followed, covering the proposed activities of the section, and the meeting closed with a smoker, which gave the members present an opportunity to meet informally, and to discuss the founding of the section and plans for its future growth.

Utah Steel Industry Grows

The Utah Society of Engineers was addressed recently by Morris Rosenblatt, manager of the plant of the Utah Steel Corporation at Midvale. Mr. Rosenblatt spoke of the present work of the plant, and of the future extension of the steel and iron industry in Utah, based upon the iron deposits of Iron and Carbon counties. The Midvale plant is producing 200 tons of standard steel bars and rods daily. Preparations are being made to increase this output, and also to make light-weight steel rails. In 1917 the company, which for some time had been producing wrought iron, installed an open-hearth furnace, which has since continuously produced steel from scrap material collected throughout the inter-mountain region. Three hundred and fifty to 450 men are employed, and in 1920 the payroll amounted to $750,000. Steel to the value of $3,000,000 was produced. A larger output is expected for the coming year. The Western States, Japan, China, and other foreign countries offer a market for Utah's steel.

MEN YOU SHOULD KNOW ABOUT

M. I. Goldman has completed a study of salt domes on the Texas and Louisiana coast.

William Parsons has joined the engineering force of the Darwin Silver Co., at Darwin, Cal.

Norman Carmichael, general manager for Arizona Copper Co., Clifton, Ariz., is in New York City.

W. A. Coughlan, of Sault Ste. Marie, Ont., is now with Consolidated Asbestos, Ltd., at Thetford Mines, Que.

Benjamin D. Stewart has been reappointed by Governor Thomas Riggs as territorial mine inspector for Alaska.

B. M. Walton has accepted the position of manager for Porcupine Paymaster Mines, Ltd., at South Porcupine, Ont.

C. E. Siebenthal, geologist, of the U. S. Geological Survey, is doing geologic work in the Joplin district, Missouri.

James P. Porteus, superintendent of the Bonney mine, Lordsburg, N. M., has returned from a business trip to New York City.

G. C. Bateman, manager of La Rose Consolidated Mines, addressed the Toronto Board of Trade recently, on the mining industry of Ontario.

W. C. Campbell, mining engineer, of Toronto, who was in Africa for several years previous to his recent stay in Mexico, has returned to Toronto.

Thomas L. Chapman, who has been making examinations in the Lordsburg, N. M., and Patagonia, Ariz., districts has returned to Los Angeles, Cal.

F. W. Holler, recently superintendent for the Belmont Surf Inlet Mines, Ltd., at Surf Inlet, B. C., may now be addressed at 2145 Goodrich Ave., St. Paul, Minn.

S. C. Thompson recently appointed consulting engineer for Kirkland Proprietary Mines, Ltd., has been examining its Tough-Oakes and Burnside properties, Kirkland Lake.

Moses Johnson, formerly district inspector of mines at Lethbridge, Alta., has been appointed to a similar position in the Drumheller district. He has headquarters at Calgary.

W. H. Crago and **Frank Hutchinson**, of Duluth, Minn., with **L. D. Davenport**, of Boston, Mass., will sail from Seattle, Wash., early in June to examine iron ore and coal deposits in Manchuria.

Wilfrid Kilian, professor of geology at the University of Grénoble in the Dauphin, France, has been awarded the Gaudry gold medal, the highest distinction conferred by the Société Géologique de France.

Raymond Guyer, mining engineer, of Spokane, Wash., who recently visited Katherine, Ariz., and Ely, Nev., districts, has gone to La Jara district, Tepic, Mexico, where he is interested in a gold property.

Duncan McDonald, district inspector of mines at Calgary, Alta., is now general superintendent of the Mine Rescue and First-Aid Department of the Canadian Department of Mines, for the province of Alberta.

Charles D. Walcott, secretary of the Smithsonian Institution, was awarded the Mary G. Thompson gold medal by the National Academy of Sciences, on April 26, "for distinguished research in geology and paleontology."

Stewart Campbell, of Hailey, Idaho, who was elected mine inspector for the State of Idaho last fall, is making his first official visit to the mines of northern Idaho. He recently spent about three weeks in the Cœur d'Alene district, and expects to return in the fall to make a more extended investigation.

C. V. Corless, president of the Canadian Institute of Mining and Metallurgy, **Dean R. W. Brock**, of the University of British Columbia and former director of the Geological Survey of Canada, and **J. J. Denny**, metallurgist at the Nipissing mine, recently received honorary degrees from Queen's University.

Dr. M. Y. Williams, professor of paleontology in the University of British Columbia, Vancouver, B. C., and formerly geologist on the staff of the Canadian Geological Survey, is in charge of one of three parties sent out by the Canadian Geological Survey to make a geologic survey of the Mackenzie River district.

Dr. Mariano Ospina Perez is now director of the national school of mines at Medellín, Colombia. Dr. Perez, who succeeds the late Dr. Tulio Ospina in this position, is a mining engineer of experience and the president of several mining companies. He is also the recently elected head of the firm Tulio Ospina y Cia., mining factors, Medellín, Colombia.

Mining and metallurgical engineers recently in New York included: **Edouard L. Foucar**, of San Francisco, Cal.; **A. B. Shutts**, of the American Ores & Asbestos Co., Globe, Ariz.; **D. S. Clements**, of Pittsburgh, Pa.; **P. W. Donovan**, of E. J. Longyear Co., Minneapolis, Minn.; **C. Vey Holman**, of Rockland, Me.; **W. A. Rukeyser**, of Montreal, Que.; **Frank A. Edson**, of the Oklahoma Geological Survey; **Erskine Ramsay**, of Birmingham, Ala.; **Edward H. Cook**, of Culiacan, Sinaloa; **R. H. Barksdale**, of Richmond, Va.; **Prof. R. W. Brock**, dean of the University of British Columbia, Vancouver, B. C.

SOCIETY MEETINGS ANNOUNCED

Executive Board of Federated American Engineering Societies meets in St. Louis, Mo., on June 3.

Arizona Chapter of American Mining Congress meets at Bisbee, Ariz., on June 13. J. E. Curry, of Bisbee, is secretary.

Ontario Mining Association meets at Cobalt, Ont., in June. Arrangements are in charge of Balmer Neilly, 120 Bay St., Toronto.

Great Lakes meeting of **American Society of Mechanical Engineers** will be held at Cleveland, Ohio, on June 13 and 14. Further information may be had from C. E. Davis, 29 West 39th St., New York City.

OBITUARY

Edward B. Rosa, chief physicist of the U. S. Bureau of Standards since 1910, died suddenly in his office at Washington, D. C., on May 17, at the age of sixty. Dr. Rosa first attained national prominence by developing the respiration calorimeter used in Professor Atwater's nutrition experiments. Most of his chief work has been in the advancement of electrical science. Among his notable contributions was the establishment of the laws governing electrolytic corrosion. During the war he developed a number of instruments of great usefulness, including the geophone, for accurately locating mining operations. He also devised improved direction finders for radiotelegraphy. Dr. Rosa was secretary of the International Commission on Electrical Standards, a member of the American Engineering Standards Committee, and of many learned societies, including the United States National Academy of Science.

In the death of **William S. McCornick**, on May 18, Salt Lake City, Utah, has lost one who for almost fifty years was a beneficent and forceful influence in the development of the state. Mr. McCornick, who was eighty-four years old, went to Utah in 1873, and engaged in a banking business first known as White & McCornick and later as McCornick & Co. From that time onward he gave generous support to worthy enterprises of all kinds, so that he was justly regarded as one of the builders of Utah. Mr. McCornick early recognized the mining opportunities of the state and the potential value of the mining industry. Among other things, he helped to further the development of such properties as the Silver King Coalition, the Daly West, and the Centennial-Eureka. In 1899, when the United States Mining Co., bought control of the Centennial-Eureka, a check for $1,385,000 passed through the McCornick bank and was cashed there, and this hung for years in Mr. McCornick's office. At the time of his death Mr. McCornick was a director in the Silver King Coalition, the Utah Power & Light Co., and in the American Smelting & Refining Co., as well as in many enterprises not connected with mining.

THE MINING NEWS

LEADING EVENTS

Safety Campaign Undertaken in Utah

State Industrial Commission and U. S. Bureau of Mines Unite in Effort To Reduce Number of Accidents

A safety first campaign to reduce the number of accidents in Utah mines has been inaugurated by the state industrial commission co-operating with the U. S. Bureau of Mines, C. A. Allen, state mine inspector, and Dr. A. L. Murray, of the bureau, being in charge of the work. As approximately 40 per cent of fatal accidents in Utah mines are attributed by state and federal inspectors to carelessness on the part of the workers themselves, and only from 10 to 12 per cent to faulty conditions, it can readily be seen what may be expected from a campaign of education.

First aid and mine rescue classes have been given by instructors and crews of the mine rescue car, following the usual custom, and this instruction made to fit in with the general educational movement. From Jan. 16 to April 19, in all 376 men have taken first-aid training and 42 men mine rescue work; 1,790 men have attended safety rallies at which the ideals of "safety first" were emphasized and the dangers of carelessness illustrated by moving pictures furnished by the Bureau of Mines and the Red Cross.

The school children are being interested, and 1,219 have enlisted as "safety and health scouts," pledging themselves to be careful and to urge their parents to be careful. In the case of each child joining the movement the parent or guardian signs his personal approval of the movement toward increased safety in Utah, and pledges his support. The full campaign is being carried on in Ophir, Eureka, Park City, Coalville, and Bingham and other camps. The Garfield and Murray smelters have permanent safety organizations and so were not visited. The industrial commissioner is furnishing funds for posters, literature, pledge cards, buttons, rental, and incidental expenses; also some of the speakers. The Bureau of Mines supplies the mine rescue car and the workers.

C. & H. President Heads Copper Export Association

John D. Ryan resigned as president of the Copper Export Association at the meeting of the stockholders. Mr. Ryan has been president of the association since it was formed and declined re-election, but will continue as a member of the executive committee. R. L. Agassiz, president of the Calumet & Hecla Mining Co., was elected to succeed Mr. Ryan.

WEEKLY RÉSUMÉ

The Silver King Coalition Mines Co. and the Daly West Mining Co., both of Park City, Utah, have decided to resist the recent attempt of the American Smelting & Refining Co. to abrogate its smelting contracts with them, under the plea that the rates are too low to permit it to earn a profit. A safety campaign has been undertaken in various camps in Utah by the State Industrial Commission and the U. S. Bureau of Mines in an effort to reduce the number of accidents. At Tonopah and Divide strike conditions have changed but little, although the operators are endeavoring to bring in workmen from other districts. The striking miners at Rochester, Nev., have returned. At Bisbee, Ariz., the Night Hawk Leasing Co. has discovered an important body of high-grade bornite. In Minnesota the Palatine Mining & Development Co. has been organized to operate the Paulson mine in the Gunflint Lake district, near the Canadian boundary. Word has come that the Mount Lyell copper company in Tasmania will shut down June 16.

At Washington the draft of the proposed revision of the mining law is still held up. The Committees on Mines and Mining are said to favor delaying making any changes in assessment work requirements until the revision referred to is considered. Representative Hayden has introduced a bill granting exclusive rights, in certain states, to prospect for copper deposits under certain conditions.

F. H. Brownell, vice-president of the American Smelting & Refining Co., was elected chairman of the board. All other officers and members of the executive committee were re-elected.

Republic Iron & Steel To Abolish Eight-Hour Day With Overtime

Iron-Ore Properties of Company Not Affected by Order

Announcement has been made by the Republic Iron & Steel Co. that hereafter the basic eight-hour day with overtime will be abolished at its plants near Youngstown, Ohio. Where the working day constitutes ten to twelve hours, straight time on an hourly basis will be paid. For some time prior to this order, all overtime was settled on a basis of time and one-half. It has been indicated that other independent manufacturers will take the same course, and if they do so more than 15,000 employees will be affected. Such orders affecting the iron ore properties of the company in the Lake Superior district have not as yet been received.

A. S. & R. Abrogates Contracts With Two Park City Companies

Refuses To Smelt Silver King Coalition and Daly West Ores at Rates in Existing Contracts

A controversy over a proposed increase in smelting rates between the Silver King Coalition Mines Co. and the Daly West Mining Co., both of Park City, Utah, on the one hand, and the American Smelting & Refining Co. on the other, is being watched with much interest by the mining men of the state. Both mining companies, which hold contracts with three and four years still to go, respectively, have been notified by the smelting company that smelting charges on ores and concentrates shipped after May 15 will be raised. The matter hinges about the interpretation of the disabling clause in the smelting contracts, which, as quoted by W. Mont Ferry, of the Silver King company, reads as follows:

"In cases of acts of nature, strikes of any kind, affecting the operations of the contracting parties, fires, floods, shortage of cars, financial crises, war or insurrections, or any cause whatsoever which, being beyond the control of the contracting parties or either of them, shall make it a disability on the part of the mining company to ship the product herein contracted, or for the smelting company to receive, purchase and treat such product, the parties hereto shall be relieved of all responsibility or claim for damage for failure to ship or receive the product; but shipments and receipts shall be resumed as soon as the disabling cause is removed and the period of such interruption or interruptions shall be added to the time provided for in this contract."

According to Mr. Ferry, "as far as the language of the contract pertains, the only disability under which the American Smelting & Refining Co. can possibly be laboring is disability to make a profit treating the King Coalition ores and concentrates under the schedule of rates agreed upon." G. W. Lambourne, of the Daly West company, has asserted that his company will take a determined stand with the Coalition in the controversy. In his opinion the advance in the cost of smelting would not make the disability clause operative. When the smelters were making large profits, he says, mining companies were not — to his knowledge — approached with an offer of a more reasonable reduction charge.

The point of view of the smelting company is given by J. M. Bidwell, manager of the Salt Lake office of the American Smelting & Refining Co., as follows:

"Each contract contains a provision that when and if conditions arise in the

smelting business beyond the control of the company, which render the smelting of their ores unprofitable at the contract rates, or make it a disability or serious hardship to receive and smelt them, then the contracts may be suspended. The contracts also provide that in case market or mining conditions make it a serious hardship for the mining companies to ship ores, they shall not be obligated to ship them. In other words, if the cost of mining became excessively high, or the metal prices extremely low, and the mining companies cannot ship at a profit under the contract, they are not obligated to ship their ores. . . . Of course, the smelting company can shut down and avoid all dispute, but that is a situation which it is now using every effort to avoid, because of the effect that course would have on the mining industry and on the people of the state. . . . Since the contracts were made, smelting costs have gone up tremendously and the result has been that for a considerable period of time the smelting company has been receiving and smelting ores from these properties at a heavy loss. The smelting company has borne these losses without complaining until they are unable to do so any longer, and on account of the present existing financial and metal market conditions, the smelting company feels that it is not fair for the mining companies to ask them to continue taking these ores at such heavy loss. Since these contracts were first made the freight rate on lead bullion has increased approximately $12 per ton. The price of coke has increased over $5 per ton. The cost of labor, limestone rock, coal, steel, and other products, and all other factors entering into smelting the ores have increased materially."

Mr. Bidwell further states that the company offers to treat the ores of the two protesting mining companies at cost, and would figure these costs each month, and that as soon as these costs were lowered, as the company expects will soon be the case, the mining companies would be given the benefit, and adds that the smelting company feels that the welfare of mining and smelting enterprises are so interwoven that only by the most cordial co-operation can these industries survive present conditions.

On the other hand, in regard to the rise in production costs, it is pointed out by the mining companies that this increase has extended to all branches of enterprise, and it is stated that mine operators have suffered as heavily or even more heavily than the smelters. The new rates proposed by the smelter are stated to be 25 per cent higher than those in force at present, that is, $8 a ton higher. It is intended to continue to offer ores to the smelting company, according to official statements, at the old rates, and if these are refused the ores will be sold on the open market and legal action will be taken to collect from the A. S. & R. the difference in the price received for the ores as compared with the price received if smelted under the A. S. & R. contract. The A. S. & R. are short of lead ore at present, so that it is said to be apparently a poor time to ask an increase in smelting rates.

B. H. & S. Co. Completing Tests on Electrolytic Zinc Processes

Tainton Method Likely To Be Selected for Proposed New Plant, According to F. M. Smith

Final tests are now being made by the Bunker Hill & Sullivan Mining & Concentrating Co. to determine which of two electrolytic processes will be adopted for the proposed zinc plant to to be erected by the company at Kellogg, Idaho. The two processes are the Anaconda and the Tainton, the latter being in successful use in a plant at Martinez, Cal. Frank M. Smith, director of the Bunker Hill smelter, states that the Tainton process seems to have some advantages over the Anaconda process and will probably be adopted. It will be almost a year before construction begins on the new electrolytic zinc plant. It will have an initial output of 25 tons per day, and is intended primarily for treating zinc-lead ores from the Star mine. The company plans however, to accept custom business, and as soon as conditions justify the capacity of the plant will be increased to handle the ores from Pine Creek and all others that are offered.

Marsh Mines Recent Settlement A Lucky One

Vein East of Fault Proved Not To Cross East End Line — Point Immaterial Now

Since the settlement of the litigation between the Marsh and Hecla companies, the first-named company has continued drifting on the Russell vein to prove its position with respect to Marsh ground, and when this has been accomplished work will be transferred 1,000 ft. below to the Gertie tunnel, from which a crosscut will be run which should cut the vein in about 450 ft. According to the statement submitted to the stockholders at the recent meeting, after paying all debts the company had a cash balance of $89,699. A dividend has since been declared of 2c. per share, amounting to $40,000, which leaves a balance of almost $50,000 for development purposes. It will be recalled that the Hecla company paid Marsh $112,500 in settlement of the apex litigation, and it is this payment that makes the dividend possible.

In closing a letter to stockholders outlining plans of the company, Edward Pohlman, president of the Marsh, states that development work on the Russell claim has located the vein east of the fault and that "it has been conclusively shown that the vein will pass out through the north side line of the Russell claim, instead of crossing the east end line. Now that the settlement has been effected, it is immaterial whether the apex of the vein crosses either line, but had no settlement been reached before proving the vein in the position in which it was located east of the fault, the company would have found itself in a compromising position, as it would have been difficult to sustain its claim of extralateral rights against the Hecla company."

Paulson Mine at Gunflint Lake, Minn., To Be Reopened

Palatine Mining & Development Co., Recently Organized, Also Acquires Atikokan Furnace

A new company known as the Palatine Mining & Development Co. has been formed for the development and operation of iron-ore properties in Minnesota. The company has acquired the Paulson mine, in the Gunflint Lake district, in Cook County near the Canadian boundary. The company has also acquired the blast furnace formerly owned by the Atikokan Iron Mining Co. situated at Port Arthur, Ont., Canada, which will be enlarged and modernized to treat all ores coming from the new property.

The ore in this district is generally magnetic, with traces of sulphur and a high percentage of silica. Owing to the complexity of the deposit, some of the ore will require concentration and roasting before it reaches the furnace, but it is expected that it will be possible to ship some direct to the furnace without treatment.

Party of Engineers Will Go to Manchuria

A group of engineers and geologists will sail from Seattle on June 3 for China, where they will make a geological examination and report for the South Manchuria Railroad Company, covering the iron and coal deposits owned by the company in the vicinity of Anshan and Mukden, Manchuria. The party will be composed of W. H. Crago, Duluth, Minn.; Frank Hutchinson, Duluth, Minn.; Dean W. R. Appleby of the school of mines at the University of Minnesota; W. R. Emmons, geologist for the State of Minnesota; Warren J. Meade, Madison, Wis., and L. D. Davenport, of Boston, Mass.

New 100-Mile Railroad Proposed for Northern Ontario

Provided the Ontario government will guarantee the bonds of the company to the extent of $3,500 per mile for the construction of 100 miles of railway, the Northern Light Railway Co. proposes to commence operations as soon as possible to provide transportation for several new mining camps of North Ontario. It is planned to run westward from Swastika on the Timiskaming & Northern Ontario line to Gowganda, Matachewan and West Shining Tree, and later to build a loop from the same point eastward touching Kirkland Lake, Larder Lake and Skead Township camps, returning to the T. & N. O. at Boston Creek.

Mount Lyell To Shut Down

The Mt. Lyell Mining & Railway Co. will shut down June 16, according to a cable dispatch received by the Department of Commerce. It is said that this is the result of the refusal on the part of the miners to accept a reduction in wages. About 1,500 men are affected.

NEWS FROM WASHINGTON

By PAUL WOOTON
Special Correspondent

Draft of Revised Mining Law Still Held Up

Mining Committees Favor Withholding Assessment Work Legislation — Action on War Minerals Also Delayed

The draft of the proposed revision of the mining law has not been delivered to the Committees on Mines and Mining as had been expected, owing to the necessity of perfecting some of the language from a legal viewpoint. The law officer of the Bureau of Mines was sent to New York to assist in that work.

Both the Senate and House Committees on Mines and Mining have decided, in view of the imminence of general revision of the mining law, to withhold legislation with regard to assessment work. The committees favor a change which will permit assessment work to be done during the fiscal rather than the calendar year.

In this connection the delegate from Alaska has introduced in the House of Representatives a bill providing that assessment fees on mining claims may be diverted for road-building purposes. The bill provides that the $100 annual payment on each mining claim may be made direct to the Treasurer of Alaska for road improvements in the vicinity of the claim or that the owner may do road or trail work in the vicinity of his property and receive the same credit as would have accrued to him had he done improvement work on the claim itself.

Former soldiers would be relieved from assessment work on any mining claims that they may hold for a period of five years, from July 1, 1921, if a bill introduced by Representative Lineberger should become a law.

The House Committee on Mines and Mining met in executive session on May 20, but none of the bills before the committee was reported out. It was decided to postpone final action on legislation bearing upon supplemental war minerals relief awards so as to give the Comptroller of the Treasury an opportunity to review the Dolbear case. This action was taken in the hope that the Comptroller may interpret existing law so as to permit a supplemental award when new evidence shows that the claimant should receive the amount asked despite the fact that he had accepted a previous award as full settlement of the claim.

Government's Silver Purchases

Purchases of silver under the Pittman Act amounted to 302,000 fine ounces for the week ended May 21. This brings the total purchases of silver since the enactment of the Pittman Act to 54,120,197 fine ounces.

Exclusive Prospecting Rights Proposed in Hayden Bill

To Encourage Search for Copper Deposits—Permit Limited to Three Years and 1,280 Acres

In an effort to encourage prospecting on the public lands in Arizona, New Mexico, Nevada, and Utah, Representative Hayden, of Arizona, has introduced a bill authorizing the Secretary of the Interior to issue prospecting permits which will give the exclusive right, for a period of three years, to prospect for copper on the public lands in the states mentioned, in an area not to exceed 1,280 acres. The bill provides that operations must begin within one year of the date of the permit and that within two years after the date of the permit at least one drill hole or one shaft must have been sunk to a depth of not less than 500 ft., unless a deposit of copper be discovered at a lesser depth. At the end of three years the holder of the permit must have a drill hole or a shaft with an aggregate depth of not less than 1,500 ft., unless copper should have been discovered at a higher level.

Provision is made for the extension of the permit. The same conditions apply to a tunnel or a drift. On any claim held under the mining laws, the holder of that claim will have a preference right to a prospecting permit. In the case of the discovery of a valuable deposit of copper the permittee is to be given a patent upon payment of $5 per acre.

Souvenir Gold Dollar for Grant Centenary

A bill has been introduced in Congress providing for the coinage of a souvenir gold dollar in commemoration of the centenary of the birth of General U. S. Grant. The Secretary of the Treasury is authorized by the bill to purchase in the open market the quantity of gold bullion necessary to coin 200,000 of these memorial dollars.

Mme. Curie at Dedication of New Cryogenic Laboratory

Next in importance to the gathering at which the President presented Mme. Marie Curie with a gram of radium on behalf of the women of the United States, was the ceremony in connection with the dedication of the new Cryogenic Laboratory of the Bureau of Mines. At that ceremony Director Bain, of the Bureau of Mines, presented Mme. Curie with a carefully selected specimen of the carnotite ore typical of the ore from which the gram of radium had been extracted. Mme. Curie was also presented with a jar of the first ore taken from the Colorado deposit.

$35,000 Appropriation Approved for Non-Metallic Inquiry

Industries To Benefit Will Also Contribute Substantially—Director Bain Explains Need

An appropriation of $35,000 "for inquiries and scientific and technologic investigations concerning the mining, preparation, treatment and utilization of heavy clay products, cement, feldspar, slate, and other non-metallics," has been approved by the Appropriations Committee of the House of Representatives. This practically insures its ultimate approval. The Director of the Bureau of Mines had asked for $47,000 in order to carry on this work.

To the sum appropriated by Congress will be added a substantial fund contributed by the industries which hope to benefit from the result of this work. This study will be conducted in cooperation with the Bureau of Standards. The Bureau of Mines intends to devote its work to the mining and preparation of the materials, whereas the Bureau of Standards, which has an appropriation of its own for the purpose, will look after qualities and standardization of the finished product.

Director Bain of the Bureau of Mines appeared before the committee to explain the need for this appropriation. He said that comparatively few studies of the non-metallics have been made. He pointed out that there is a special need for research on the items covered by this appropriation. Despite the shortage of housings, and great demand for brick, he said, there had been a decrease of 35 per cent in production as compared with 1913. This is despite the fact that the price of common brick has increased in that period from $5.54 per thousand to $25 a thousand in New York. He told the committee that from 30 to 50 per cent of the cost of brick was represented by the cost of fuel. As the total value of the brick and tile output is $184,000,000 a year, great opportunity is given to reduce the costs by effecting greater efficiency in the use of fuel.

The problem in slate, Mr. Bain explained to the committee, is to utilize the waste. He believes that much of the slate which is not suitable for slabs can be utilized. The Bureau already has developed the fact that it is a valuable constituent of road surfacing materials and is also used for roofing compounds.

Mr. Bain also pointed out that there is a tendency on the part of large users of cement to erect their own plants, which create a demand for fundamental data as to the character of the raw materials.

Senate Gets Montana Resolution Urging Passage of McFadden Gold Bonus Bill

Senator Walsh presented to the Senate on May 17 a joint resolution by the Montana Legislature urging the Federal Congress to secure the immediate enactment into law of the McFadden Gold Bonus Bill. The resolution called attention to the fact that the gold-mining industry of the United States is lagging and production is shrinking. Attention was also called to the fact that the character of gold mining has changed since the coinage value of gold was fixed, more than 100 years ago. At that time gold was obtained from placer gravel and from shallow workings in rich quartz veins. Labor was cheap, long hours were in vogue and supplies inexpensive. On the other hand, the resolution points out, practically all gold today is obtained from deep mining and from low-grade deposits. The operation now requires expensive machinery and appliances, skilled labor and expensive supplies.

Senator Walsh also presented a resolution of the Montana Legislature stating that it is the sense of that body that the Federal Government should place a tariff upon the importation of chrome ores at the earliest possible moment, so as to protect the domestic producers of that ore.

Frelinghuysen Bill Would Put Coal Statistics in Department of Commerce

By proposing to transplant the division of coal statistics of the U. S. Geological Survey in the Bureau of the Census, the Frelinghuysen coal bill, now on the Senate calendar, promises to precipitate one of the major issues involved in the reorganization of the Government departments. The matter is of interest to all mineral industries. All statistics on mineral resources of the Geological Survey are obviously in the same category.

Senator Frelinghuysen's action is based on the belief that statistics as to coal production and distribution are commercial rather than scientific in character. Therefore he believes they should be placed in the statistical bureau of the Department of Commerce.

It is certain that this provision of the bill will meet with opposition on the ground that such statistics should be gathered in close co-operation with the technical men who utilize them. The point also is made that no fault has been found with the accuracy of the mineral statistics gathered by the geologists of the U. S. Geological Survey, whereas the statistics of the Bureau of Census covering technical subjects have been generally regarded as possessing little value.

NEWS BY MINING DISTRICTS

Special London Letter

Waihi Gold's Latest Report Indicates Several Years' Life Remaining—Negotiations With Soviet Government Arouse Interest

BY W. A. DOMAN

London, May 13—Although the Waihi gold mine is not the great and valuable property it formerly was, it still apparently has several years' life ahead of it. At least the superintendent states in his latest report that the company is now assured of adequate supplies of mining timber for some years. In its early career the Waihi was regarded as one of the great investment mines of the world, and to date it has distributed over £5,000,000 in dividends and paid £646,000 in income tax, from gold and silver obtained of a value of £12,987,000. The interesting point now is the ore reserves. Owing to higher wages, shorter working hours and lowered labor efficiency, no less than 175,950 tons of ore are temporarily written off the quantity of developed reserves. The mine management calculates on a basis of 84/- per oz. for gold and 2/- for silver. At Dec. 31 last the ore reserves stood thus:

General	523,828 tons assey value 31.27/-
Suspense	254,737 tons assey value 38,8/-
Total	778,565 tons assay value 33.73/-

Approximately one-third, it will be seen, cannot now be extracted, as a goodly proportion of it must be in the form of pillars. It will be noted, too, that this ore contains the highest values. In all, the mine has about twenty separate reefs, the principal being the Martha, the Royal, the Edward and the Empire. Extraction is maintained at a fairly regular level. In 1918 it was 91.7 per cent, in 1919, 91.1 per cent, and last year 91.9 per cent. Recent developments have not shown a high grade of ore, apart from some small rich vein strikes. Dividends have been reduced from 1/- per quarter to 1/- per half year. The directors hope soon to return 10/- per share and write down the capital by that amount. The number of shares issued is 495,907 out of 500,000 of £1 each.

The Robinson Deep prospects are not so healthy looking as they were thought to be when the capital was rearranged at the end of 1915. By the scheme something like twenty-six annuities were provided for. It seems doubtful whether the mine will last out this period. In these deep areas money has a nasty knack of running short, and the Robinson Deep already owes the Consolidated Gold Fields and the Central Mining Corporation £150,000 each. This joint loan should be repaid at the end of next year, but a big "if" has arisen. To continue operations most profitably it will be necessary to sink a new vertical shaft further to the south, which means to a greater depth, and at an estimated cost of £290,000. There does not seem much probability of the lenders getting back their £300,000 at anything like date.

A good deal is expected within the next fortnight from the visit of M. Krassin to Moscow. The Soviet government has discovered that financiers and mining engineers are essential to the welfare of the country, and its emissary is in Russia endeavoring to negotiate an agreement. Great hopes are entertained in London that all mining and other properties that were "nationalized" will be returned to the respective companies plus the value of the plant and machinery that was destroyed or removed. I understand that the British Government has supported the demands of the different companies. In the event of restoration and reparation the Russo-Asiatic Corporation would benefit and no long period should elapse before production of the precious and base metals is again in full swing An estimate made of the value of the company's properties is in the neighborhood of £56,000,000

CANADA

Ontario

Iron Ore Reported Near Elk Lake

Elk Lake—A discovery of hematite iron ore has been made in Jarrow and Morel Townships in the Temiskaming district, northern Ontario, within 14 miles of the Temiskaming & Northern Ontario Ry. at Elk Lake. The ore is a massive hematite, occurring in sedimentary rocks of conglomorate and slate formation. It was discovered by Frank Westcott, of Elk Lake.

Kirkland Lake — The 18,702 tons of broken ore in the main stope of the Lake Shore at the 400-ft. level is sufficient to keep the 60-ton mill in operation for one year, it is said. The management has adopted the policy of keeping the mill going on development ore, and the ore in the stope will be kept as part of a large reserve in anticipation of an enlargement of the mill. With this object in view a second stope which will be 300 ft. long is being opened up.

Representatives of English interests have been making an examination of the claims owned by the Highland-Kirkland company, about half way between Swastika and Kirkland, with a view to acquiring an interest. Some surface

work has been done on the property the results of which are stated to be satisfactory.

The option held by American interests on the Kirkland Townsite has been allowed to lapse, as plans for financing the operation of the property could not be carried out. Surface work disclosed the occurrence of seven veins carrying low gold content.

Cobalt — At the Coniagas arrangements are made for the treatment of 200 to 300 tons per day of sands and slimes, in addition to about 300 tons of milling rock. The slimes are cyanided and the old sands re-ground and treated by oil flotation.

West Shining Tree—The Wasapika is said to have made financial arrangements by which sufficient funds have been secured to put the property on a producing basis with a 200-ton mill. Contracts have been made for machinery and supplies for the first of two mill units. A start will soon be made in opening up the 100 and 200 levels.

British Columbia

Decision Expected Soon in Insinger-Cunningham Case

Nelson—Justice Murphy, who presided over the recent session of the local assize court, has promised decision within a few weeks in the cases of Insinger *vs.* Cunningham and Insinger *vs.* Bank of Montreal. The litigation arose out of a lease and bond taken by Clarence Cunningham, mining operator of the Slocan, on the Hewitt and Lorna Doone group of claims, near Silverton, B. C., in 1918.

Kaslo—Leasing operations at the Whitewater mine have been temporarily suspended, because of the usual spring troubles with water underground.

Trail—Ore received at the Consolidated smelter during the week ended May 14 consisted of 8,676 tons from company's mines.

ALASKA

Alaska Treadwell Shipping Equipment To Nixon's Fork Property

One hundred tons of mill machinery was recently shipped from Treadwell, Alaska, on the steamship "Almeda" to Anchorage, where it will be transshipped to the Alaska Treadwell's new gold property near McGrath, on the Kuskokwim River. Operations are in charge of Livingston Wernicke, one of the Treadwell's engineers, who has been at work on the property for the last two years.

The Maid of Erin Mining Co. has started moving an air compressor from Haines to the Rainy Hollow district, where the claims of the company are situated. The property has been taken under bond by capitalists from Portland, Ore., who plan to do considerable development work during the summer.

The Vermont Marble Co., of Tokeen, Alaska, recently purchased the holdings of the Alaska Marble Co. at the same place. The new company will employ between 50 and 100 men in the quarry during the present season.

MEXICO

Sinaloa

Los Tajos Mine, in Badiraguato District, Being Opened Again—Sinaloa River Power Project Will Aid Mining

Badiraguato—In the vicinity of Santiago de los Caballeros, in the Badiraguato district, there is considerable activity. The Los Tajos mine, belonging to J. B. Sheppard, of Denver, Col., is under option to some California capitalists. This property has been abandoned for eleven years, and will now be cleaned out and put in condition to produce the necessary ore on which to operate a reduction works. This has been a famous producer of high-grade silver shipping ore in years past. It is opened up principally by a tunnel on the vein for about 1,700 ft. Former reports show that there is blocked out more than 20,000 tons of 50-oz. silver ore, not considering the high grade, which will run up to 1,000 oz. per ton and better. The same syndicate will operate several other properties in the same vicinity. It is planned to install a mill immediately after the rainy season, which begins in July and ends in September.

Development work on the famous San Luis Ganzaga mine, recently purchased by an Eastern syndicate, is progressing rapidly under the superintendency of E. B. Holt. A 75-ton flotation mill will be installed after the rainy season. This mine is supposed to contain large quantities of milling ore of a grade better than 30 oz. silver per ton. The property is also in the district of Badiraguato.

The Shreveport Mining & Development Co. is working actively on its properties at La Tuna in the Badiraguato district. These have records of production, but have been abandoned since the revolution began. Water power is to be used to operate the compressor and air drills. Milling machinery will be on the ground by Oct. 1.

Mocorito—The Palmarito Leasing Co., in the Mocorito district, is still sinking its three-compartment shaft to cut the vein at the 200 level. It is said to be the intention of the company to install a 500-ton mill, with a new power plant complete. This vein is about 90 ft. wide, and has indications of proving one of the biggest silver deposits in Mexico.

The Potrero Mines Co., also in the Mocorito district, has curtailed operations on account of water shortage. This is one of the few gold mines in this district and has a good gold production record.

Sinaloa—In the Sinaloa district there is a project under way for developing the water power of the Sinaloa River. The natural conditions are favorable. This river, at the point known as Bacubirito, makes a "horse-shoe" curve of about nine miles. At the mouth of the horseshoe the distance is only about 300 ft. and the vertical fall is about 130 ft. With the completion of the tunnel, it should be possible to develop several thousand horsepower, which would be a great relief to the mining industry in this state, and would undoubtedly put in operation a number of mines which are unable to operate on account of the high price of wood fuel.

Bacubirito—The placers at Bacubirito are known to contain large quantities of "place gold," and some large nuggets have been found by the natives, who wash the gravel in pans and rockers. It is stated that the parties interested in the power project will also make an exhaustive examination of the placers with a view to making them commercially profitable when worked on a large scale.

In all the mining agencies of the state great activity in denouncements is reported. Virgin properties are being denounced as well as those which were producing before the revolution. With the looked-for increase in the price of silver, it is expected that there will be a marked increase in mining activities before winter.

Coahuila

Certain Mining Agencies Closed Owing to Changes in Districts

Torreon—Recent changes have been made in the mining districts in this section. The mining agencies at Mapinni and San Juan de Guadalupe, in Durango, and those of Viesca, San Pedro and Parras, in Coahuila, have been closed. The agency at Torreon now embraces the municipalities of Torreon, Viesca, Matamoros and San Pedro in Coahuila, and Mapimi, Lerdo, San Juan de Guadalupe and San Bartelo in Durango. The agency at Concepcion del Oro, Zacatecas, embraces the municipalities of Concepcion del Oro, Sierra Hermoso, San Pedro Ocampo and Mazapil.

Saltillo—La Sultana Mining Co., failing to have a quorum at a recently called meeting, issued a second call for stockholders to meet May 22. According to Mexican laws official business can be transacted on a second call regardless of the number of stockholders present.

Sonora

The Ahumada Lead Co., of which Dr. L. D. Ricketts is president, J. C. Greenway and H. C. Dudley vice-presidents, John F. Bankered secretary-treasurer, and William D. Thornton, of New York, a director, has taken over, in the Sierra de los Lamentos, in northern Sonora, several groups of mines including the Erupcion ledge, which is said to have been explored for 1,300 ft., with 200 000 tons of high-grade lead developed, carrying 6 or 7 oz. silver. The Ahumada company, organized in Delaware, is represented south of the line by a number of Mexican corporations, but especially by the Erupcion Mining Co.

Durango

Tamazula—Walter C. Minsch is operating his silver property in the Tamazula district, and has a remarkably good showing.

ARIZONA

Night Hawk Leasing Co., at Bisbee, Strikes High-Grade Bornite Below 650 Level

Bisbee—The Night Hawk Leasing Co. has struck some high-grade bornite ore in a winze from its 650 level. The ore is on the Lone Star claim, which is a small fraction between the Night Hawk and Boras claims. It is probably a part of the sulphide orebody opened up by the Boras Leasing Co. on its 600 level. The winze is 21 ft. below the level and has so far opened up 15 ft. of solid ore. Development of this ore is being pushed as rapidly as possible. There is no doubt that it is an important discovery for the company. According to its annual report it has blocked out 10,000 tons of 12 per cent copper ore in one orebody and 5,000 tons of 8 per cent in a second body, besides a considerable amount of lower grade ore. Last year the company produced a little over 1,000,000 lb. of copper. Ore shipments were discontinued Dec. 1, but development work has been going on since then. The Boras Leasing Co. is continuing work on the 700 level. Two raises are being driven under the stopes on the 600 level.

The installation of a hoist is progressing at the Cole No. 3 shaft of the Calumet & Arizona Mining Co. The old headframe is to be replaced by a new one. The results obtained by the Boras and Night Hawk leasing companies have been so good that the C. & A. has mapped out a program of prospecting and development which will be started as soon as the installations now under way are completed.

Tombstone—The Bunker Hill Mines Co. has arranged with the El Paso smelter for the treatment of 1,000 tons per month of silver-lead and silver-manganese ore with a high percentage of lime. Several lessees that were idle will begin work again at once. The Co-operative mill will be ready to start within a week. This will give much work to miners here that have ore of too low grade to ship to El Paso.

Clifton.—Arizona Copper Co. has resolved to discontinue operations for the present in view of the accumulation of stocks and the general condition of the copper market.

Globe—Miami Copper will shut down its steam power plant this month and use hydro-electric power from the Roosevelt dam, brought by the wires that have served the Inspiration and Magma, now closed. The Roosevelt system at present has an excess of power available.

Jerome—The new Verde Central ore strike has been demonstrated to be at least 30 ft. wide and the crosscut is still faced in chalcoyprite and bornite of very good value. The drift is to be pushed onward about 200 ft., to get under a good ore showing found in the tunnel at 4,500 ft.

Dundee-Arizona is receiving machinery for its experimental leaching mill, which is to be in operation within a month. It is claimed that the process will require only five pounds of acid to each ton of carbonate ore treated.

Phoenix — Representative Carl Hayden has written from Washington that no further exemption from mining claim assessment work can be expected. He states opposition to the extension measure introduced by Senator Bursom of New Mexico has been expressed to him and to Secretary Fall and Chairman Rhodes, of the House Committee on Mines and Mining, though both favor a bill, introduced by Mr. Hayden, that changes the period for doing assessment work from the calendar to the fiscal year.

Operation of the industrial commission bill passed by the last State Legislature has been suspended, owing to submission of a suit brought by interests understood to be associated with the Arizona State Federation of Labor and with attorneys whose principal business has been prosecution of personal injury actions. Opposition also is understood to have come from accident insurance companies. The commission, already appointed by Governor Campbell, includes Herbert H. Hodgson of Morenci, L. L. Henry, of Globe, and Joseph Lord, of Phoenix, the last considered the labor representative. Each is to receive $4,000 a year. Compensation for injuries will be provided by a fund based upon an appropriation of $100,000, this to be repaid by premiums. Especially in the mining counties, most of the court business has been furnished by damage suits, which were expected to be almost eliminated under the new system.

Nogales — Luis A. Martinez, vice-president of the Sonora Bank & Trust Co., has entered suit in the Federal court, at Nogales, Sonora, for restitution of the historic Planchas de Plata mines, on the ground of failure to comply with a contract of sale.

NEW MEXICO

Octo Mining Co. Reorganized — J. H. White Takes Over Last Chance Property

Lordsburg—H. G. Green, of Colorado, and associates have taken a thirty-day option for a lease and option on the Robert E. Lee claim owned by Small and Brial.

Smith and Reynolds have given a thirty-day option on the Ruth claim to Frank G. Kaerwer. This property has been a shipper, and has a strong showing of lead-silver ore exposed in several 100-ft. shafts.

The Great Eagle mine has shipped a car of 90-mesh ground fluorspar running 98 per cent CaF_2, this being a preliminary mill-run sample from the only fluorspar mill west of the Rosiclaire-Kentucky field. Additional tables are being installed to meet the demand for high-grade ground material. The completed mill will have a capacity of 100 tons daily. J. R. Hibbs is in charge of construction.

The enlarged mill on the Co-operative silver property is running regularly and is reported to be satisfactory. The capacity has been increased to 100 tons daily. Insurance on the company store at Lordsburg, which burned several weeks ago, has been adjusted. About forty men are reported at work.

George Foreman, of Los Angeles, general manager of the Octo Mining Co., has returned from a conference with eastern stockholders. He reports that a new organization composed of old stockholders has been perfected, to be known as the Anita Copper Co., of which George Bill, of El Centro, Cal., is president. The new company holds $25,000 in notes against the Octo company, which will be taken care of. New stock will be issued for old, share for share, leaving a large block of stock in the treasury for development purposes. Work is expected to begin about July 1, and a new shaft will be sunk on the good ore showings on the east end of their ground. A new assay office will be installed.

John H. White, formerly of the Climax Molybdenum Co., of Colorado, and two associates have taken over the Last Chance silver property from Robert F. Fitz, of Los Angeles. The mine, which is opened to the 300 level, has been unwatered and sampled. Indications point to favorable returns, and a development force will be put to work soon. At present about ten men are employed. The ground will be thoroughly explored at depth, and a concentration-flotation mill installed when conditions justify. The property has a favorable record. Mr. White will remain, with Arch Storke as mine superintendent.

COLORADO

Portland To Deepen No. 2 Shaft — Vindicator Opens New Shoot

Independence—A rich ore shoot has been opened on the 2,000 level of the Vindicator. A drift has been advanced 200 ft. on a vein averaging 4 ft. in width. Selected samples assay 1,000 oz. of gold and 75 oz. of silver per ton. A large flow of water was met when the new ore shoot was opened. As soon as this is under control, the shaft will be sunk another 100 ft. and the ore shoot will be explored on the new level. The discovery has served to increase confidence in the value of deep-level development in the district.

Victor — The Portland Gold Mining Co. will sink its No. 2 shaft another 300 ft. from the present 2,450 level. This new deep-level development, for the purpose of prospecting the rich orebody now opened on the bottom level, is being watched with interest by officials of neighboring companies, and the success of this work will no doubt be the signal for resumption of shaft sinking at several other mines

The Index mine is being developed and operated by lessees, who have opened shipping ore on the 600 level. The present hoisting equipment may be replaced in the near future by an electrically operated plant with a view to increasing capacity. J. S. Anderson is superintendent.

Gold Hill—The Victory Gold Mining Co. is operating a lease through the Howard shaft of the Mary McKinney Gold Mining Co. The ore is being shipped to the Golden Cycle mill. E. P. Arthur, Jr., is manager.

Cripple Creek — The Columbine Granite Mining Co. will develop the Sangre de Christo property on Tenderfoot Hill. David Heaton is president and Sam MacDonald superintendent.

IDAHO

Cœur d'Alene District

New Company Leases Sidney—Paragon Shaft Being Deepened

Pine Creek—The recent strike on the Sidney, practically on the surface and on a vein parallel to the one which was supposed to have been the main fissure, has attracted much attention, and a company of Kellogg business men has taken a lease upon the property for two years. The vein has been exposed by open cuts for a distance of 150 or 200 ft., showing in places 8 ft. of ore, much of it of shipping grade. The leasing company is now engaged in taking out ore from the surface, samples of which run as high as 54 per cent lead and 86 oz. of silver. Shipments will be made by auto truck to the Bunker Hill smelter.

Murray—The shaft on the Paragon, now down 60 ft., is being extended to a depth of 300 ft. Good shoots of lead-silver and zinc ore have been found in tunnel levels and on a level driven from the bottom of the present shaft, the company in past years having shipped 30 carloads of lead-silver and zinc concentrates. At a depth of 300 ft. the vein will again be opened up, and results above stated indicate an increased amount of lead. The company owns a 100-ton mill, which has been placed in good condition in anticipation of early shipments. L. W. Stedman, manager of the Paragon Consodiated Mining Co., died two weeks ago. Following his death the property was visited by F. O. Hammer, of St. Paul, secretary of the company, who announced that development plans would proceed without interruption. Control of the Paragon is owned in St. Paul.

Adair—The great crosscut being run by the Montana-Idaho Copper Co. to explore what is commonly known as the Monitor ground is expected to cut the Monitor vein in about 1,100 ft. and at a depth of 1,700 ft. This tunnel, when completed, will be about two miles long and its extension is of great advantage to the copper section around Adair, as none of the properties have been proved at depth. The Monitor ground covers the divide between Idaho and Montana. It was developed years ago by a shaft started practically on the summit and which was extended to a depth of 700 ft. Ore was taken from the various levels, hauled seven miles to Saltese and shipped with profit. The showing of ore on the lowest level is reported to be fully as good or better than that in the upper levels. It is to tap this orebody that this long tunnel is being run.

MONTANA

Butte District

Butte & Plutus Cuts Norwich Vein on 400 Level—Part of Timber Butte Mill May Be Reopened

Butte—More attention than heretofore is being given to silver mining by the Anaconda Copper Mining Co., particluarly in the western part of the Butte district, a section at one time the principal producer of the metal. The company is now crosscutting on the 600 level of the Nettie mine for the Burlington vein, a large fissure which has outcroppings about 50 ft. wide.

Operations have been resmued at the Nettie. It would occasion no surprise were the Anaconda to resume the mining of silver ore at the Emma mine, as this property has been kept free of water and a considerable tonnage of silver-zinc ore is available for immediate mining.

Butte & Plutus has cut the Norwich vein on the 400 level about 325 ft. north of the station, disclosing from 6 to 7 ft. of 12-oz. silver ore. This ore body will be drifted upon and further crosscutting will be done.

A hoisting plant and air compressor are to be installed soon at the West Butte Mining Co. property in the western part of the Butte district. A power line will be built. Pittsburgh capital is behind the project, this being a recently organized corporation.

Churn drilling is being used by East Butte in an effort to determine the thickness of quicksands in a portion of the company's property through which it is planned to raise to the surface. The new shaft will serve to lessen materially the distance through which it is necessary to crosscut before the orebodies are reached.

Little is being done by North Butte aside from keeping the mine workings in repair and some development work. Drifting is in progress on the Edith May vein on its deeper levels, with the results said to be satisfactory.

It is expected that a portion of the Timber-Butte Milling Co.'s concentrator, where the Elm Orlu's ores are treated, will be reopened in consequence of the development of a good tonnage of 20-oz. silver ore on and above the 800 level.

NEVADA

Tonopah Operators Attempting To Break Strike—Rochester Silver Corporation's Men Return

Tonopah — Strike conditions in the Tonopah and Divide districts remain unchanged so far as getting together of employer and employee is concerned. The companies are now importing men to take the places of the strikers. On May 9 about fifty men came in on the train, but none remained to work. The men were met at the train by several hundred strikers and persuaded that conditions had been misrepresented to them by the employment agencies. Automobiles were loaned or rented, and practically all the men started on the return trip to the place from whence they came or desired to go. On May 14 another delegation of about fifty men were brought in via train, and being more carefully guarded than previously against the abusive and persuasive tongues of the strikers, a fair proportion of them were retained and started to work May 16 at the Tonopah Extension. More men are to be imported, and a determined effort is to be made to break the strike. There is no indication of a possible compromise, as is evidenced by the tone of the reply by the operators to a letter addressed to them on May 16 by an association of the business men of Tonopah, the letter urging the operators to adjust their differences with their former employees for the welfare of the community as a whole. The reply was "that the operators can make no recession from the scale of wages offered, and that the effort to bring in men to operate the mines will be continued. If by reason of intimidation or lack of protection this effort fails, the operators will be convinced that the community does not desire the properties opened, and they will be indefinitely closed down."

This, it is said, leaves no room for argument as to the present state of mind of the operators, although it is quite generally conceded by the public that a compromise by wage reduction of 50c., instead of the 75c., per day could be effected. If this be true, the condition exists that for the sake of 25c. per day 800 men are losing at the rate of $120,000 per month in wages, and the companies about the same amount in strike expenses and loss in earnings. This would indicate that despite the apparent prevalent disregard for the value of money, the two-bit piece still holds a prominent place in local popular estimation.

A few of the smaller companies are doing limited work by contract. West End continues to operate normally, mine production being 200 tons per day. The last bullion shipment by this company, representing the result of operations for the latter half of April, was $70,000. Work has been resumed by the West End in Tonopah "76" ground. Crosscutting is being done on the 800 level in favorable formation.

Many small properties are working in the Divide district, with no new developments of importance reported.

Klondyke—The Knox Divide, on May 6, made the third payment, amounting to $10,000, on the Golden State group of claims in this district. The last payment is due in August of this year. The Knox Divide took over the Golden State group on a bond and lease in May, 1920, and during the last several months has been shipping about 500 tons of ore per month to the Desert mill at Millers. A considerable tonnage of broken ore has accumulated in the stopes since the labor strike closed the custom mills at Tonopah and Millers. The condition of the mine is said to be good, development work being done on a fissure vein in lime.

Lessees are working in the Original Klondyke mine. The Ben Hur Divide

is drifting on a vein on the 70 level, its property being between the Knox and the Original Klondyke properties.

Pioche—The Telephone mine of the Amalgamated Pioche Mines & Smelters Corporation has been leased to Tony Mitsoff, and work has been started on the property.

Rochester—On May 11 the employees of the Rochester Silver Corporation returned to work, after having been on strike for less than two weeks against a 50c. reduction in wages. At a second meeting the men voted unanimously to return, basing the decision on present economic conditions. This brings the Rochester scale of wages 25c. above the Tonopah reduced scale.

Round Mountain—The Round Mountain Mining Co., employing about fifty men at its hydraulic placer mine at Round Mountain, about sixty-five miles north of Tonopah, is having a prosperous season. There is more water available this year than usual, which means a longer operating period. A new and possibly valuable vein has recently been uncovered by placer operations. It is estimated that at present rate of operation it will require fifteen years to work out the proved placer ground belonging to the company.

Nevada Hills—It is reported that the old Nevada Hills mine, near Fairview, is to be reorganized by Reno people, recent geological investigations having disclosed a possible continuation of the rich orebodies which were faulted and lost.

JOPLIN-MIAMI DISTRICT

Missouri-Kansas-Oklahoma

American Metal Co.'s First Year's Operations Successful

Success of the American Metal Co.'s mining operations in the Joplin-Miami zinc and lead district is apparently assured, for although the initial drainage cost on the leases developed by its subsidiary, the Chanute Spelter Co., west of Baxter Springs, Kan., was large, the results of the first year's operations were particularly satisfactory.

Production at the company's Hartley mine, above mentioned, was begun April 14, 1920, and on April 14, 1921, a recapitulation of the year's work showed the following:

Dirt mined and milled, tons	115,700
Zinc concentrates	19,326
Lead concentrates	728
Total concentrates	20,054
Percentage of concentration	17.3
Prospect drifting during year, ft.	491
Prospect drilling during year, ft.	17,583
Average cost per rock ton	$2.25

It is further stated that the average width of the orebody mined was 70 ft., and the height from 25 to 70 ft. The total length of the stopes carried was 730 ft., and the total area of land mined was 1.1 acres.

It is estimated by the officials of the company that four to five years of work ahead has already been blocked out for this mine, with excellent probability of still more development later. One of the orebodies developed by drilling during the year is approximately half a mile from the mill, but the plan at present is to have the dirt run over this plant.

The Chanute company is now moving the Velie Panther mill, formerly near Tar River, Okla., to what is known as the Brewster lease, a short distance to the northeast of the Hartley mine. It is expected this mill will be ready for operation about Aug. 1. The company itself is handling the construction work.

D. F. Haley is general manager for the Chanute company, with G. B. Corless, assistant manager, and T. J. Rightly, superintendent.

WASHINGTON

Hearst-Chichagof Company Seeks Permit To Erect Dam

Seattle—The Hearst-Chichagof Mining Co., 316 First Avenue South, Seattle, has filed application with the Federal Power Commission for permission to erect a dam 34 ft. high and 100 ft. long at the outlet of an unnamed lake, and 36-in. wood-stave pipe 1,800 ft. long to a power house at the head of Didrickson Bay, Chichagof Island, Alaska.

MICHIGAN

Marquette Range

Surface Water Shuts Down Barnes-Hecker Mine—Few Properties Shipping

Ishpeming—Water from two small ponds has been finding its way into the Barnes-Hecker mine. A drainage ditch is being dug to divert it from the ponds into one of the rivers flowing to Lake Superior. It has been impossible to carry on mining work, because the pumps could not handle the heavy flow.

Only a few of the mines on the Marquette Range are shipping ore to the docks. These are sending out the daily hoist. Shovel work has started at but one property. The independents are awaiting orders from their sales departments, with 1921 prices unannounced as yet.

The valuation of the mines on the Marquette Range has been placed at $35,831,000 for 1921, as compared with $33,252,000 for 1920. The total valuation of the three Michigan ranges for 1921 is $117,694,208, as against $113,945,439 last year, the Marquette Range bearing the greatest part of the increase. The state tax commission recently completed hearings on all of the iron ranges in Michigan and the operators were given the opportunity to present their grievances.

Menominee Range

Air Line from Quinnesec Falls to Chapin Mine Damaged by Dynamite

Iron Mountain—The Oliver Iron Mining Co. is making shipments from the Chapin, at Iron Mountain; the Aragon, at Norway, and the Delta, at Iron River. All this ore is going to the Escanaba docks. Thus far the corporation is the only operator making regular shipments. It is unlikely that the Clifford and Munro pits will be operated at all during 1921.

Unknown persons tried recently to hamper operations at the Chapin mine by blowing up the 24-in. pipe line which carries air from Quinnesec Falls to the mine, and they partly succeeded. Two great holes were torn in the pipe by dynamite, cutting off the mine's supply of air, and it was impossible to operate the hoist, compressors or drills until the damage was repaired. One skip broke away, there being no air for the brakes, and dropped until it had pulled an empty skip into the headframe. The company laid off a number of men a few weeks ago, and it is thought that someone who was let go set the charge.

The assessed valuation of the Menominee Range mines, exclusive of the two operating properties on the Wisconsin side, has been placed at $32,938,000 for 1921, as compared with $32,550,000 in 1920.

MINNESOTA

Mesabi Range

Mesabi Iron Co.'s Temporary Power Plant Destroyed by Fire

Babbitt—The temporary power plant of the Mesabi Iron Co. was recently destroyed by fire, which will delay the final completion of the first unit of the concentrator. At present this is approximately 80 per cent completed, but it is feared that, owing to this accident and to the failure of some of the machinery to arrive, it will be impossible to complete the plant for operation until the next shipping season.

Virginia—Plans have been made and some machinery has been installed for dewatering the Lincoln mine, a property of the Interstate Iron Co., which was flooded owing to an accident to the pumping system. The present temporary equipment will be electrically driven.

Ely—The development at the La Rue mine has progressed to such a point that a spur track of five miles is being built from the Duluth & Iron Range R.R. to the property. It is expected that the mine will be operating and shipping in the near future.

Nashwauk—The Hawkins mine, operated by the Wisconsin Steel Co., again started operation last week. The present plans also include the shipping of the stockpile, which is being forwarded daily.

KENTUCKY

Kyva Ferromanganese Corporation Resumes Operations

Winchester — The Kyva Ferromanganese Corporation, of Winchester, has resumed making ferrosilicon, spiegeleisen and ferromanganese at the 10-ton electric furnace recently taken over, which is at Cleveland, Tenn. It is planned to enlarge this furnace. According to its letterhead, the company has mines at Seven Mile Ford, Va.

THE MARKET REPORT

Daily Prices of Metals

May	Copper, N. Y., net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
19	12.75@13.00	31.875	32.875	5.00	4.85	4.80@4.85
20	12.75@13.00	32.25	33.25	5.00	4.80	4.80@4.85
21	13.00	32.00	33.00	5.00	4.80	4.80
23	13.00	31.75	32.75	5.00	4.75	4.80
24	13.00@13.25	31.25	32.25	5.00	4.75	4.75
25	13.00@13.25	31.375	32.25	5.00	4.75	4.75

*These prices correspond to the following quotations for copper, "delivered": 13@13.25c. for May 19 and 20; 13.25c. for May 21 and 23; 13.25@13.50c. for May 24 and 25.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York, cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin.

London

May	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3 M		Spot	3 M	Spot	3 M	Spot	3 M
19	74⅞	74⅜	75	181¼	182¼	24⅝	24½	28	28¾
20	75¼	74⅞	76	183¼	183½	24½	24½	28¼	28¾
21	...	...	...	.....	.....	...	...	...	...
23	75½	75¼	76	184	184½	24⅜	24⅜	28	28½
24	74	74	76	181	181½	24	23⅞	27¾	28
25	74⅜	74½	76	182	182¼	24⅛	23⅞	28	28⅜

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

May	Sterling Exchange	Silver			May	Sterling Exchange	Silver		
		New York, Domestic Origin	New York, Foreign Origin	London			New York, Domestic Origin	New York, Foreign Origin	London
19	400	99¼	58¾	33¼	23	397	99¼	59⅛	33⅜
20	399½	99¼	58⅝	33¼	24	393¾	99¼	58	33⅜
21	399	99¼	58⅝	33¼	25	396	99¼	58⅛	33¼

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine.

Metal Markets

New York, May 25, 1921

The last week has been marked by exactly the same tendencies which characterized the market during the preceding week; namely, increasing firmness in the price of copper and easier tendencies for lead and zinc. Tin, as usual, has closely followed London. Domestic demand from consumers of all these metals is exceedingly small.

Copper

The larger producers are confident of higher prices, and are holding their metal at premiums of ⅛@¼c. over the prices at which most of the small sales have taken place. Today they are unconcerned sellers for June delivery at 13.50c., delivered. Some of the smaller interests have let a little metal go at the prices which we quote, but the business has been of small volume. Today, a small amount of spot copper could probably be had at 13.25c. delivered, June at 13.25@13.37c., and July at 13.50c. It is difficult to buy forward copper. The only reason for selling copper at present prices is to raise cash, and the sale of forward metal does not do this.

Export demand continues of fair volume at correspondingly advancing prices. France, Germany, and Japan continue the chief buyers through the Copper Export Association, but English dealers are also buying through outside agencies. It is understood that the price is now 13.75c., c.i.f. European ports. Some commotion has been caused in the London market by the reported attempt of American interests to corner the market for spot standard, London metal dealers seeming to feel that Americans should confine their efforts to producing the metal, and allow them the privilege of manipulating the prices. The New York Metal Exchange is seeking to broaden its copper market by instituting a new and more attractive form of contract.

Lead

The A. S. & R. official contract price of lead continues at 5c., New York and St. Louis, and no immediate change is expected.

Practically no lead has been sold on a New York basis during the last week, and not for some time has the market here been so quiet. Consumers seem to have provided for practically all of their June requirements during the recent buying movement. One lot of 1,000 tons was sold to an out-of-town consumer for delivery beginning next month at a slight advance over the price which we quote, but this business was exceptional. In St. Louis there has been an active selling campaign, but it has not resulted in many sales—only in reducing prices. A firm bid of 4.70c. either today or yesterday would doubtless have been accepted, but we heard of no business being done at that figure. Although the market has been inactive, further recessions in the price are hardly to be expected, as the relation of production to consumption, and present costs, do not warrant prices even as low as those now quoted. In the last two or three days there have been some inquiries from Middle-Western consumers, and also from Europe and South America. Foreign orders, however, are likely to go to Spanish producers.

Zinc

An overanxiety on the part of some producers in a market that is particularly unreceptive of virgin zinc has succeeded in reducing the quotations to 4.75c., East St. Louis. The larger producers are not pressing their metal on the market at these prices, an attitude they have maintained since the price first dropped from 5c. a few weeks ago. High-grade zinc has been selling at 6.50@6.75c. per lb., delivered.

Tin

The tin market continues of little interest. Most of the sales of Straits have been of a speculative nature. Lower grades have been bought in small volume by a few consumers, but the business is generally quiet. Some metal is finding its way into high-grade solders and babbitts, the demand for

which is said to be satisfactory when judged by pre-war standards. Tin for forward delivery is quoted at the same price as for spot. Electrolytic is quiet at slight concessions over Straits.

Arrivals of tin, in long tons: May 18, London, 50; May 19, Straits, 50; May 23, Liverpool, 200.

Gold

Gold in London: May 19th, 102s. 8d.; 20th, 102s. 8d.; 23d, 103s.; 24th, 104s. 2d.; 25th, 103s. 4d.

Foreign Exchange

On Thursday, May 19, sterling reached $4, the highest figure since April 6, 1920, when the post-war advance culminated at $4.03¼. On Monday, a bad break occurred, probably owing to speculative manipulation, and yesterday sterling sold as low as $3.925, but recovered later. On Tuesday, May 24, francs were 8.55c.; lire, 5.46c.; and marks, 1.64c. Canadian exchange in New York, 10⅜ per cent discount. (Holiday in Montreal.)

Silver

The market has been influenced by selling by China and the Continent, the sharp fall in sterling exchange, and covering for bear account against exchange operations. There are no important buyers in sight, India demand being small and China still lifeless. On the other hand, supplies in this market continue only moderate, with no pressure to sell, so that tendency of the market is uncertain. A shipment of 200,000 oz. was received in New York this week from Germany, which is unusual, and was caused by tax on German imports to England, where the silver is ordinarily sold. Purchases of domestic silver under the Pittman Act amount to 55,425,697 oz. to May 24th.

Mexican Dollars—May 19th, 45; 20th, 44⅜; 21st, 45; 23d, 45¼; 24th, 44½; 25th, 44½.

Other Metals

Quotations cover large wholesale lots unless otherwise specified

Aluminum—List prices of 28@28.5c. are nominal. Outside market, 22@23c. per lb.; 22½c. for imports, duty paid. Metal being imported in anticipation of a higher tariff.

Antimony — Chinese and Japanese brands, 5½c.; market dull. W.C.C. brand, 5⅞@6½c. per lb. Cookson's "C" grade, spot, 9⅜c. Chinese needle antimony, lump, nominal at 4½c. per lb. Standard powdered needle antimony (200 mesh), nominal at 6@6½c. per lb.

White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, wholesale lots, 6½@7c.

Bismuth—$1.50@$1.55 per lb., 500-lb. lots.

Cadmium—Range $1@$1.10 per lb., in 1,000-lb. lots. Smaller quantities, $1.10@$1.25 per lb.

Cobalt—Metal, $4 per lb.; black oxide, $3@$3.10 per lb. in bbls.; sulphate, $1.35 per lb. in bbls.

Iridium—Nominal, $250@$300 per oz.

[1]**Molybdenum Metal** in rod or wire form, 99.9 per cent pure, $32@$40 per lb., according to gage.

Nickel—Standard market, ingot, 41c.; shot, 41c.; electrolytic, 44c. Small tonnages, spot, 35@40c.

Monel Metal—Shot, 35c.; blocks, 35c., and ingots, 38c. per lb., f.o.b. Bayonne.

Osmium—$70@$80 per troy oz.

Palladium—$65@$70 per oz.

Platinum—$72@$75 per oz.

Quicksilver—Nominally, $46@$48 per 75-lb. flask. San Francisco wires $48.50. Prices are considerably below import parity and represent quotations on liquidation lots.

[1]**Rhodium**—$150 per troy oz.

[1]**Selenium**—Black powdered, amorphous, 99.5 per cent pure, $2@$2.25 per lb.

[1]**Thallium Metal**—Ingot, 99 per cent pure, $20 per lb.

[1]**Tungsten Metal**—Wire, $35@$60 per kilogram, according to purity and gage.

Metallic Ores

Chrome Ore—Guaranteed 50 per cent Cr_2O_3 foreign ore with a maximum of 6 per cent silica, 45@55c. per long ton unit, f.o.b. Atlantic ports.

Iron Ore—Lake Superior ores, per ton, Lower Lake ports: Old Range bessemer, 55 per cent iron, $7.45; Mesabi bessemer, 55 per cent iron, $7.20; Old Range non-bessemer, 51½ per cent iron, $6.70; Mesabi non-bessemer, 51½ per cent iron, $6.55.

Magnetite Ore—F.o.b. Port Henry, N. Y.: Old bed 21 furnace, $5.80; old bed concentrates, 63 per cent, $6.70; Harmony, cobbed, 63 per cent, $6.70; new bed low phosphorus, 65 per cent, $9.50.

Manganese Ore — 25c. per unit, seaport; chemical ore (MnO_2) $55@$60 per gross ton, lump; $70@$75 per net ton, powdered.

Molybdenum Ore—85 per cent MoS_2, 55@60c. per lb. of contained sulphide, New York.

Tantalum Ore—Guaranteed minimum 60 per cent tantalic acid, 50c. per lb. in ton lots.

[1]**Titanium Ores**—Ilmenite, 52 per cent TiO_2, 1½@2c. per lb. for ore. Rutile, 95 per cent TiO_2, 12c. per lb. for ore, with concessions on large lots or contracts.

Tungsten Ore—Scheelite or wolframite, 60 per cent WO_3 and over, per unit of WO_3 $3@$3.25, f.o.b. Atlantic ports.

Uranium Ore (Carnotite)—Ore containing 1½ per cent U_3O_8 and 5 per cent V_2O_5 sells for $1.50 per lb. of U_3O_8 and 75c. per lb. of V_2O_5; ore containing 2 per cent U_3O_8 and 5 per cent V_2O_5 sells for $2.25 and 75c. per lb., respectively; higher U_3O_8 and V_2O_5 content commands proportionately higher prices.

Vanadium Ore—$1.50 per lb. of V_2O_5 (guaranteed minimum of 18 per cent V_2O_5), New York.

[1]**Zircon**—Washed, iron free, 3c. per lb.

[1]**Zirkite**—According to conditions, $70 @$90 per ton, carload lots. Pure white oxide, 99 per cent, is quoted at $1.15 per lb. in ton lots.

[1]Furnished by Foote Mineral Co., Philadelphia, Pa.

Zinc and Lead Ore Markets

Joplin, Mo., May 21—Zinc blende, per ton, high, $26.25; basis 60 per cent zinc, premium, $23.50; Prime Western, $22.50; fines and slimes, $20@$17.50; average settling price, all grades of zinc, $24.10.

Lead, high, $64.70; basis 80 per cent lead, $60@$55; average settling prices, all grades of lead, $59.40 per ton.

Shipments for the week: Blende, 6,564; lead, 1,062 tons. Value, all ores the week, $221,310.

The establishment of a freight differential of 80c. per ton, with a haulage differential of 20c. per ton, in favor of the Waco area against the Oklahoma-Kansas area, admits the payment of $1 higher basis price for Waco ore. As all demand for blende for zinc-rolling purposes is temporarily abandoned, ore quotations may be accepted as premium referring to Waco price and Prime Western as referring to Oklahoma-Kansas price for the present. The basis price of lead was dropped $5 and of zinc ore $2.50 this week.

Platteville, Wis., May 21—Lead ore, basis 80 per cent lead, $55@$58 per ton base. No sales or shipments of finished blende. Shipments for the week: Lead ore, 80 tons. Shipments for the year: Blende, 11,461; lead ore, 830 tons. Shipped during the week to separating plans, 495 tons blende.

Non-Metallic Minerals

Asbestos — Crude, No. 1, $2,000@$3,000; No. 2, $1,400@$2,000; spinning fibres, $400@$1,000; magnesia and compressed sheet fibres, $325@$500; shingle stock, $110@$150; paper stock, $60@$75; cement stock, $17.50@$30; floats, $8.50@$15, all per short ton, f.o.b. Thetford, Broughton, and Black Lake mines, Quebec, Canada; 5 per cent to be added as export sales tax.

Barytes—Crude, 88 to 94 per cent barium content, $10@$12 per net ton; ground (white) $24@$30 in bags, carload lots; (off-color) $22@$26 in bags, carload lots; all f.o.b. South Carolina points. Foreign barytes, prime white material, $25 per net ton f.o.b. Atlantic seaports. Western grades are $24.50. Crude quoted $7 per long ton, f.o.b. Cartersville, Ga. Small lots as low as $5.

Bauxite—High-grade French bauxite, $8@$10 per ton, Atlantic ports. American quotations the same. Consumers generally well supplied. Prices vary according to grade. Crude, unground, $16.50 per ton; ground, $22; calcined, ground $35; unground, $45, f.o.b. plant.

Chalk—English, extra light, 5@5½c. Domestic light, 4½@5c.; heavy, 4@4½c. per lb., all f.o.b. New York.

China Clay (Kaolin)—Crude, $8@$10; washed, $10@$12; powdered, $15@$20; bags extra, per net ton, f.o.b. mines, Georgia; powdered clay, $15@$20, f.o.b. Virginia points. Domestic lump, $10@$20; powdered, $25@$30; imported lump, $15@$25, f.o.b. American ports; powdered, $35@$45, f.o.b. New York.

Emery—Turkish emery, 6@6½c. per lb., depending upon fineness. Inferior grades, 3½c. f.o.b. New England points.

Feldspar—Crude, $8@$14 per gross ton, f.o.b. Maryland and North Carolina points; $7.50@$10, f.o.b. Maine; ground, $27@$30, car lots, f.o.b. Baltimore; ground, $17@$21, f.o.b. North Carolina points; $17@$21 per ton, No. 1 ground, f.o.b. New York State; $21@$23 per ton, ground, f.o.b. Maine.

Fluorspar — Gravel, guaranteed 85 per cent calcium fluoride and not over 6 per cent silica, $20@$25 per ton, f.o.b. Illinois and Kentucky mines; acid, glass, and enamel grades, $40@$55; ground, suitable for acid, chemical or enameling purposes, $32@$35; lump, $15, f.o.b. Lordsburg, N. M. Ground acid grade, 97 per cent CaF_2, $32, New Mexico, Canadian price generally $18 (Canadian currency) per ton, f.o.b. mines.

Fuller's Earth—16 to 30 mesh, $21; 30 to 60 mesh, $23; 60 to 100 mesh, $19; 100 plus mesh, $15, f.o.b. plants, Pennsylvania. California grades, $15@$25, f.o.b. mines. Imported, English, $24@$27, f.o.b. Atlantic ports.

Graphite—Ceylon lump, first quality, 7@7½c. per lb.; chip, 5½@6c.; dust, 3¼@4c. No. 1 flake, 6½c.; amorphous crude, ¾c.@2¼c.

Gypsum—Plaster of paris in carload lots sells for $4.25 per 250-lb. bbl., alongside dock, New York. Raw crushed rock, $3.50@$4.50; calcined stucco, $9; f.o.b. works, Illinois.

Kaolin—See China Clay.

Limestone—Crushed, New York State shipping points, ¾ in. size, $1.40@$2 per net ton; 1½ in., $1.50@$2. Prices for other sizes practically the same. Agricultural limestone, $2.50@$4.50 per net ton, f.o.b. eastern shipping points, depending upon analysis.

Magnesite, Calcined — Crude, $12@$15 per ton. High-grade caustic calcined, lump form, $30@$40 per ton. Plastic calcined, $56 in barrels, carload lots, f.o.b. California points. Atlantic seaboard, $60.

Dead-Burned — $38 per net ton, Chewelah, Wash.; $58@$64, Chester, Pa. Austrian grade, $55@$60 per ton, f.o.b. Baltimore. (Magnesite brick—See Refractories.)

Mica—India block mica. slightly stained, per lb.: No. 6, 35c.; No. 5, $1.20; No. 4, $2.50@$3; No. 3, $3.50@$4; No. 2, $4.50@$6; No. 1, $5.50@$6.50. Clear block: No. 6, 50c.; No. 5, $1.75; No. 4, $3.25; No. 3, $5; No. 2, $6.50; No. 1, $8; A1, $6.50@$8.50; extra large, $25; ground, wallpaper grade, $90@$160 per ton (depending upon quantity); ground roofing mica, $25@$70, all f.o.b. New York.

[1]**Monazite** — Minimum of 6 per cent thorium oxide, quoted $30 per unit, duty paid.

Phosphate Rock—Per long ton, Florida ports: 77 per cent tricalcium phosphate, $12.50; 75 per cent, $11.50; 75@74 per cent, $11; 70 per cent, $6.75; 68 per cent, $6.25; 68@66 per cent, $6.

[1]Foote Mineral Co., Philadelphia, Pa.

Pumice Stone—Imported, lump, 4@50c. per lb.; domestic lump, 6c.; ground, 4@7c., all f.o.b. New York.

Pyrites—Spanish fines, per unit, 14c., c.i.f. Atlantic seaport; furnace size, 14c.; Spanish lump, 12@14c.; domestic fines, f.o.b. mines, Georgia, 12 @ 14c.

Silica — Glass sand, $2.25 per ton; sand-blast material, $2.25, both f.o.b. Indiana points. Amorphous or decomposed variety, soft silica, 250 to 500 mesh, $16@$30 per ton. Ganister, crude, $2.50 per ton, f.o.b. Illinois points. Molding sand, building sand, glass sand, $2.25@$3, f.o.b. Pennsylvania points. Market reported dull.

Sulphur—$18 per ton for domestic; $18@$20 for export, f.o.b. Texas and Louisiana mines. Market quiet.

Talc—Paper making, $11@$20 per ton; roofing grades, $8.50@$13; rubber grades, $11@$18; all f.o.b. Vermont. California talc, $18@$40, talcum powder grade. Southern talc, powdered, carload lots, $10@$14 per ton; less than carload, $25, f.o.b. cars. Imported, $35@$40; Canadian, $20@$40 per ton.

Mineral Products

Arsenic — White arsenic, 7½c. per lb. in carload lots.

Sodium Nitrate—$2.75@$3 per cwt. ex vessel, Atlantic ports.

Sodium Sulphate—For 95 per cent material, $18@$20 per ton, f.o.b. mines, Idaho and Arizona, spot and six months' contract; $33@$35 per ton, New York.

Potassium Sulphate—Powder, domestic, $1.50@$1.75 per unit, basis 90 per cent, f.o.b. New York.

Ferro-Alloys

Ferrotitanium—For 15 to 18 per cent material, $200@$225 per ton, f.o.b. Niagara Falls, N. Y.

Ferrocerium—Per lb., $12@$15.

Ferrochrome—Carload lots, spot and contract, 60 to 70 per cent chromium, 6 to 8 per cent carbon, 15c. per lb. of chromium contained; 4 to 6 per cent carbon, 16@17c., f.o.b. works.

Ferromanganese—Domestic 76 to 80 per cent, $80@$85, f.o.b. furnace; resale, $90, delivered; English, $75, c.i.f. Atlantic seaports. Spiegeleisen, 18@20 per cent, $30@$32, f.o.b. furnace.

Ferromolybdenum—Standard grades, carrying from 50 to 60 per cent molybdenum metal, with low sulphur, phosphorus, and arsenic, $2.50 per lb. of contained metal, f.o.b. works.

Ferrosilicon—For 10 to 15 per cent, per gross ton, f.o.b. works, $50@$55; 50 per cent, $80@$85; 75 per cent, $145@$150.

Ferrotungsten—Domestic, 70 to 80 per cent W, 50@55c. per lb. of contained tungsten, f.o.b. works. Foreign, 50c., duty paid, f.o.b. Atlantic ports.

Ferro-uranium—35 to 50 per cent U, $6 per lb. of U contained, f.o.b. works.

Ferrovanadium—$5@$6 per lb. of V contained, according to analyses and quantity.

Metal Products

Copper Sheets—Current New York list price, 20½@20¾c. per lb.; wire, 15c.

Lead Sheets—Full lead sheets, 8.25c.; cut lead sheets, 8½c. in quantity, mill lots.

Nickel Silver — 31½c. per lb. for 18 per cent nickel. Grade "A" sheets.

Yellow Metal — Dimension sheets 17½c.; sheathing, 16½c.; rods, ⅜ to 3 in., 14½c.

Zinc Sheets—$10 per 100 lb., less 8 per cent on carload lots, f.o.b. smelter.

Refractories

Bauxite Brick—56 per cent alumina, $35@$50 per ton, f.o.b. works.

Chrome Cement—40@45 per cent Cr_2O_3, $45@$50 per net ton, and $55 in sacks, carload lots, f.o.b. eastern shipping points.

Chrome Brick—Straights, $75 per net ton, shipping point; arches, keys, wedges, $80; splits, soaps, $90.

Fire Brick—First quality, 9-in. shapes, $40@$50 per 1,000, Pennsylvania, Ohio and Kentucky. Second quality, $35@$40.

Magnesite Brick—9-in. straights, $90@$95 per net ton; 9-in. arches, wedges and keys, $100; soaps and splits, $110.

Silica Brick—9-in., per 1,000: $45@$55 in carload lots, f.o.b. shipping points.

The Iron Trade

Pittsburgh, May 24, 1921

The demand for steel has not improved during the last week, and has, if anything, grown a shade lighter. There is buying, but it is only in small lots and for prompt shipment. The Steel Corporation's specifications against contracts are fair, and it is booking a little prompt business besides. The business of independents is almost entirely in new orders. The steel industry as a whole is hardly operating at as much as 30 per cent of capacity, which means about the same tonnage as the full operation of 1902, nineteen years ago.

Fabricated steel business let in April amounted to 31 per cent of the fabricating capacity, the highest percentage shown since last September. The steel demand of the automobile industry is tapering off somewhat. Tin plate demand is phenomenally poor for the season of year.

Steel prices are steady at the levels reached about the middle of April. Orders are small and there is no incentive to cut. Lower prices seem unlikely until the mills can secure a much heavier and more economical operation by reducing prices.

Pig Iron—Extreme dullness continues to characterize the market. Scarcely any merchant iron is being made, yet furnace stocks decrease slowly. Prices remain at $24 for bessemer, $22 for basic, and $23.50 for foundry, f.o.b. Valley furnaces, with $1.96 freight to Pittsburgh.

Coke

Connellsville—Furnace, $3.25@$3.75; foundry, $4.50@$5.

A Year of Pittman Act Silver Repurchases

Treasury Buying of the Metal Indicates Decline in Production—Period of Repurchases Therefore Likely To Be Extended—British Government Repaying Silver Loan—Entire Indebtedness To Be Discharged by 1924—Silver Certificates Appearing in Circulation

EDITORIAL MARKET STUDY

ONE YEAR of repurchases of silver under the Pittman Act has passed, and during that period total purchases of 53,500,000 oz. have been made. May 13, 1921, the first anniversary, marks off about one-quarter of the total repurchases to be made—207,000,000 oz. Besides indicating the rate of sales to the Government, the figure is an accurate index of the production for the year ending the middle of May. It shows a sharp drop, being smaller than for any year since 1908, when 52,440,000 oz. was produced. Peak production occurred during the war, in 1915, and according to the U. S. Geological Survey amounted to 74,961,075 oz.; thereafter, production steadily declined.

If 143,500,000 oz. remain to be purchased, it would appear that this amount can be taken up in less than three years, assuming that silver production will continue at the same rate as in 1920—53,500,000 oz. The rate will be greatly modified, however, because of recent developments in the mining industry indirectly affecting silver production; i.e., the drastic curtailment in copper production and the tendency toward lower production in the lead and zinc industries. The modification this will have upon the duration of the repurchases of the Pittman Act can be roughly estimated from statistical data.

Heavy Decline in Silver Production Probable

In general, about 30 per cent of the silver produced in the United States is derived from dry siliceous silver ores and placer operations, about 30 per cent comes from copper ores, 25 per cent from lead ores, and the remainder, 15 per cent, from complex ores such as lead-zinc-copper ores. Copper production will soon be but a fraction of its 1920 output, say 25 per cent; lead production, particularly in the Rocky Mountain region, has been appreciably curtailed; zinc production is but a fraction of normal, but its decline is not as important to by-product silver production as in the copper and lead industries. Silver mines working strictly silver or gold-silver ores will, no doubt, operate full blast.

With these assumptions, the following distribution of the source of 1920 silver production and an estimate of the probable effect of mining conditions on production in 1921 may be made:

SOURCE OF SILVER PRODUCTION IN THE UNITED STATES
(In ounces)

From	1920	1921
Copper ores	16,050,000	4,012,500
Silver ores	16,050,000	16,050,000
Lead ores	13,375,000	11,330,000
Complex ores	8,025,000	3,000,000
Totals	53,500,000	34,392,500

This estimate, necessarily rough, points to a heavy decrease in Pittman Act purchases during the current year, which will have the effect, should the depression in nonferrous metal mining continue, of extending the duration of the silver repurchases and increasing the profits of those mining companies in the fortunate position not to have to abandon operations. It's an ill wind that blows no one good. A situation bad for the copper producer is beneficial to the silver producer. Of course no one expects the present depression to continue for long; nevertheless, it would already appear that silver repurchases will now extend well into the fifth year.

Individually, silver mines are fairly active. The largest ten producers of silver in the United States are the Anaconda Copper Mining Co., the Chief Consolidated Mining Co., the Butte & Superior Mining Co., the Hercules Mining Co., the Hecla Mining Co., the Tintic Standard Mining Co., the United Verde Copper Co., the Tonopah Mining Co., the Tonopah Belmont Development Co., and the Bunker Hill & Sullivan Mining Co. Most of these companies, as is well known, are lead mines and are steadily producing. Of the two most important exceptions, the Anaconda and Butte & Superior (the former the premier silver producer in 1920) produced 13,748,000 oz. of silver from its manifold operations in copper, lead, and zinc. The present rate of metal production means a reduction of at least 9,500,000 oz. in annual production. Butte & Superior's complete curtailment has withdrawn about 2,500,000 oz. annually.

England's Silver Payments

On May 15, 1921, Great Britain paid an installment on the silver loan, made by the United States Government, the financial machinery which enabled the Pittman Act silver to be purchased in 1918. A total of 270,121,554 silver dollars was melted under the act, of which $11,000,000 was used for subsidiary silver coinage, leaving a net melting of $259,121,554 containing 200,414,327 oz. of silver, worth $200,414,327. This figure represents approximately the total purchases of Treasury silver by the British government.

Regardless of the exact amount of the purchases of Great Britain, $122,017,633.57 was held, until recently, by the Treasury Department, to be the amount still due the United States Government. Of this sum, $17,633.57 has been paid with interest. On the remainder, $122,000,000, the British government has made two payments, one on April 15, 1921, and the other on May 15, 1921. The first payment was the interest accrued on 60 per cent of the indebtedness from April 15, 1919, and the other the interest on 40 per cent from May 15, 1919, at the rate of 5 per cent per annum. Interest payments are to be made on each 15th of October, November, April, and May, 1922, 1923, and 1924 on the same basis, calculated on the unpaid balance.

In addition to the payments of interest, the principal is to be paid in equal annual installments in 1921, 1922, 1923, and 1924 in the proportions of 60 per cent on April 15 and 40 per cent on May 15 of each year.

The two payments referred to above totaled $42,700,000; $25,620,000 of this amount represents the payment on April 15 and the remainder, $17,080,000, the payment on May 15 last.

Distributed according to the scheme of discharging the debt, the two payments made and other payments to be made in the next twelve months analyze as follows:

SCHEDULE OF BRITISH GOVERNMENT'S SILVER LOAN PAYMENTS
Interest at 5 per cent

Date of Payment	Basis	Principal	Interest	Total
April 15, 1921	(60 per cent)	$18,300,000	$7,320,000	$25,620,000
May 15, 1921	(40 per cent)	12,200,000	4,880,000	17,080,000
Oct. 15, 1921	(60 per cent)	(a)	1,372,500	1,372,500
Nov. 15, 1921	(40 per cent)	(a)	915,000	915,000
April 15, 1922	(60 per cent)	18,300,000	1,372,500	19,672,500
May 15, 1922	(40 per cent)	12,200,000	915,000	13,115,300

(a) Principal payments only made in April and May.

The scheme provides for the gradual discharge of the silver debt with interest, and is independent of any negotiations for funding the British war debt to the United States of approximately $5,000,000,000.

One of the visible effects of the operation of the Pittman Act lately become apparent to those residing in the East, is the reappearance in circulation of crisp silver certificates in various denominations. As silver was melted and shipped abroad in 1918 and 1919, silver certificates were retired and their places taken by Federal Reserve Bank notes—a step to prevent undue contraction of the currency. They are now reappearing in circulation by a reversal of the process by means of which they were withdrawn from circulation.

COMPANY REPORTS

Bunker Hill & Sullivan Surplus Increased

A report of operations of Bunker Hill & Sullivan Mining & Concentrating Co. for 1920 states that 71,071,988 lb. of lead and 1,194,478 oz. of silver was produced, at a cost of $0.0573 per lb. of lead. Operating statement follows:

Debits:		
Production costs (of 96,489.37 tons mill product):		
Mining—409,986 tons mined		$1,307,587.43
Milling—West Mill—415,257 tons mine ore	$348,535.17	
Sweeney Mill, 107,850 tons tailings	61,037.84	409,573.01
Shipping expense—97,269.77 tons concentrates shipped		27,859.73
Smelting costs:		
Freight and treatment, and lead and silver discounts		2,328,164.49
South Mill expense		7,506.63
North Mill experimental		19,336.89
Mine examinations		191,910.03
North and South mills—fire losses		55,550.42
Interest paid on bank loans		4,151.84
Net loss on reserve bonds sold		261,851.79
Worthless accounts charged off		574.40
		$4,614,066.66
Add: B. H. Smelter—Net operating loss after depreciation		246,744.65
		4,860,811.31
Credits:		
Bullion:		
Gross lead and silver value of product shipped	$7,058,394.08	
Less concentrates inventory adjustment at cost	17,526.40	$7,040,867.68
Royalties on lessees' ore		69,226.74
Net rentals and profit on light dept		19,226.88
Dividends:		
From Caledonia Mining Co	$104,648.00	
From Sierra Nevada Cons. Mining Co	19,273.48	123,921.48
Interest:		
On Kellogg loans	$3,424.81	
On bonds and other reserve securities	105,345.67	108,770.48
		$7,362,013.26
		4,860,811.31

Analysis of Surplus

Normal surplus:			
Balance Dec. 31, 1919			$7,387,580.03
Net operating surplus for 1920 before depletion	$2,501,201.95		
Less income:			
Proportion of 1920 depletion	$120,891.02		
Accrued income taxes of 1920	94,585.32	215,476.34	2,285,725.61
			$9,673,305.64
Deduct dividends paid in 1920			1,962,000.00
Balance Dec. 31, 1920			$7,711,305.64
Revaluation surplus			
Balance Dec. 31, 1919, per annual report			$36,999,332.10
Less proportion of 1920 depletion			1,238,458.56
Balance Dec. 31, 1920			$35,760,873.54
			$43,472,179.18

Quincy Mining Shows Deficit

A report of operations of the Quincy Mining Co. for 1920 shows a deficit of $530,741, compared with a net income of $416,597 in 1919. Income account follows:

Production, 19,216,070 lb. of refined copper sold for		$3,125,733.32
Profit on silver		84,379.33
		$3,210,112.65
Mining expense	$2,593,695.81	
Opening-mine expense	282,955.71	
Taxes paid in Michigan	114,516.66	
Capital stock tax	6,990.00	
Smelting, transportation, etc	430,440.38	$3,428,598.56
Deficit		$218,485.91
Interest receipts	$22,492.76	
Sales of real estate, Hancock, Michigan	2,942.00	25,434.76
		$193,051.15
Construction	$307,690.17	
Accident account	30,000.00	$337,690.17
Deficit		$530,741.32

Depreciation charges of $265,141.33 and depletion of $494,925 are not included in the above statement.

Balance Jan. 1, 1920, was $2,520,006.74; deducting deficit of $530,741.32 gave $1,989,265.42; deducting a dividend of $110,000 gives $1,879,265.42 as balance Jan. 1, 1921. Capitalization, 110,000 shares, par $25.

Magma 1920 Net Income $0.43 per Share

A report of operations of Magma Copper Co. for 1920 states that 8,854,917 lb. of copper, 303,258 oz. of silver and 4,437 oz. of gold were produced, at a cost of 18.295c. per lb. of refined copper, exclusive of depletion, but including all charges and credits. A total of 9,632,685 lb. of copper was sold at 18.022c. per lb.; and 7,152,119 lb. was on hand at the end of the year. Income account follows:

Sales of copper, silver and gold		$2,215,623.47
Add: Increase in inventory of metals		155,485.45
		$2,371,108.92
Deduct: Refined copper purchased		6,552.41
Total production of metals		$2,364,556.51
Cost of production:		
Mine and mill operations:		
Labor and material, etc	$1,295,347.77	
Depreciation	147,890.70	
	$1,443,238.47	
Freight on ore to smelter	147,494.23	
Smelting and converting	291,814.10	
Refining and freight on blister to refinery	167,173.80	2,049,720.60
Gross profit		$314,835.91
General expenses		
Selling commission and freight	$48,478.71	
Administration expenses	62,690.09	
Expenses in connection with patent litigation	48,410.93	159,579.73
Net profit		$155,256.18
Addition to income:		
Interest and discount earned		10,971.66
Gross income		$166,227.84
Deductions from income		
Loss on sale of Liberty Loan bonds	$53,649.43	
Corporate taxes	5,122.00	
Interest paid	4,910.92	63,682.35
Net income		$102,545.49

Surplus Jan. 1, 1920, was $1,627,894.14, and adding net income of $102,545.49 gave surplus Dec. 31, 1920, of $1,730,439.63. Capitalization, 240,000 shares of $5 par. Net income in 1919 was $178,077, or 78c. per share.

Plymouth Consolidated Pays Small Dividend

A report of operations of the Plymouth Consolidated Gold Mines, Ltd. (British), for 1920 states that 28,294.7 oz. of gold and 6,556.2 oz. of silver, having a total value of £121,799 9s., was produced from 91,350 tons of ore milled. Profit and loss account follows:

	£	s.	d.	£	s.	
Working expenses, California:						
Development	16 884	5	8			
Mining	61,889	17	11			
Milling	14,526	11	5			
Realization of bullion and concentrates	6,344	11	10			
Maintenance, and general expenses	10,974	13	1			
Total				110,613	19	11
General expenses, London				1,977	16	9
American taxes				2,352	11	3
Depreciation of machinery, plant and buildings				3,501	0	11
Depreciation of war loan, Liberty loan, etc				3,936	16	3
Balance, profit				2,358	3	1
				£124,740	8	2
Sales of bullion and concentrates				121,799	9	2
Rents				593	16	7
Difference on exchange				1,329	1	6
Interest				998	3	5
Transfer fees				19	17	6
				£124,740	8	2

APPROPRIATION ACCOUNT

Debit	£	s.	d.	Credit	£	s.	d.
Income tax	2,816	1	5	Balance, as at Dec. 31, 1919	13,156	13	8
Directors' percentage of profits	60	0	0	Profit and loss account:			
Dividend paid: 1s per share, March 31, 1920	12,000	0	0	Balance as per above	2,358	3	1
Balance carried forward	638	15	4				
	£15,514	16	9		£15,514	16	9

A 1s. dividend was paid on the 240,000 shares of £1 par outstanding.

MINING STOCKS

Week Ended May 21, 1921

Stock	Exch.	High	Low	Last	Last Div.
COPPER					
Adventure	Boston			*50	
Ahmeek	Boston	52	51	52 Sept. '20, Q	$0.50
Alaska-Br. Col.	N. Y. Curb	1/16	1/16	1/16	
Alloues	Boston	22	22	22 Mar. '19	1.00
Anaconda	New York	43½	41½	41¾ Nov. '20, Q	1.00
Arcadian Consol.	Boston	2½	2½	2½	
Ariz. Com'l	Boston	9¼	9	9¼ Oct. '18,	.50
Big Ledge	N. Y. Curb	1/16	¼		
Bingham Mines	Boston	....	....	10½ Sept. '19, Q	.25
Calumet & Arizona	Boston	52½	51	51⅞ Mar. '21, Q	.50
Calumet & Hecla	Boston	256	253	255 June '20, Q	5.00
Canada Copper	N. Y. Curb	....	....	*13	
Centennial	Boston			10 Dec. '18, SA	1.00
Cerro de Pasco	New York	31	29	29 Mar. '21, Q	.50
Chile Copper	New York	12¾	11⅞	12¼	
Chino	New York	27½	25⅝	26¼ Sept. '20, Q	.37½
Columbus Rexall	Salt Lake	*28	*27½	*28	
Con. Arizona	N. Y. Curb	....	....	1/16 Dec. '18, Q	.05
Con. Copper M.	N. Y. Curb			1⅛	
Copper Range	Boston	36½	35	35⅛ Sept. '20, Q	.50
Crystal Copper (new)	Boston Curb	*30	*27	*28	
Davis-Daly	Boston	7	6¾	6¾ Mar. '20, Q	.25
East Butte	Boston	9¾	9¼	9½ Dec. '19, A	.50
First National	Boston Curb	*83	*82	*82 Feb. '19, SA	.15
Franklin	Boston	2⅛	2⅛	2⅛	
Gadsden Copper	N. Y. Curb	....	....	*25	
Granby Consol.	New York	24	22½	24 May '19, Q	1.25
Greene-Cananea	New York	24⅞	23¼	23½ Nov. '20, Q	.50
Hancock	Boston	3	3	3	
Howe Sound	N. Y. Curb	2⅛	1⅞	2⅛ Jan. '21, Q	.05
Inspiration Consol.	New York	37⅛	36	36 Oct. '20, Q	1.00
Iron Cap	Boston Curb	6½	6½	6½ Sept. '20, K	.25
Isle Royale	Boston	22	21	21 Sept. '19, SA	.50
Kennecott	New York	22½	21½	21⅝ Dec. '20, Q	.50
Keweenaw	Boston	....	....	1⅛	
Lake Copper	Boston	2¼	2¼	2¼	
La Salle	Boston	....	....	2	
Magma Chief	N. Y. Curb	....	....	*21	
Magma Copper	N. Y. Curb	22	20½	22 Jan. '19, Q	.50
Majestic	Boston Curb	*13	*13	*13	
Mason Valley	Boston	1⅜	1⅛	1⅛	
Mass Consolidated	Boston	2⅜	2⅜	2⅜ Nov. '17, Q	1.00
Mayflower-Old Col.	Boston	4⅛	4	4	
Miami Copper	New York	23¾	22⅛	23⅛ May '21, Q	.50
Michigan	Boston			2⅛	
Mohawk	Boston	54	52½	53½ Nov. '20, Q	1.00
Mother Lode (new)	N. Y. Curb	5⅛	5⅛	5⅛	
Nevada Consol.	New York	12¾	12	12 Sept. '20, Q	.25
New Baltic	Boston Curb	....	....	3	
New Cornelia	Boston	16	15½	15½ Aug. '20, K	.25
Nixon Nevada	N. Y. Curb	....	....	*5	
North Butte	Boston	11⅛	10⅛	10⅛ Oct. '18, Q	.25
North Lake	Boston	....	....	⅛	
Ohio Copper	N. Y. Curb	....	....	1/16	
Old Dominion	Boston	23	22	22 Dec. '18, Q	1.00
Osceola	Boston	32½	31	32 June '20, Q	.50
Phelps Dodge	Open Mar.	†165	†155	.... Apr. '21, Q	1.00
Quincy	Boston	42	41	41 Mar. '20, Q	1.00
Ray Consolidated	New York	14¼	14⅛	14¼ Dec. '20, Q	.25
Ray Hercules	Boston Curb	*35	*35	*35	
St. Mary's Min. Ld.	Boston	39⅛	39	39 June '20, K	2.00
Senecs Copper	Boston	17⅛	17⅛	17⅛	
Shannon	Boston	0.90	0.90	0.90 Nov. '17, Q	.25
Shattuck Arizona	New York	7¼	6⅞	7 Jan. '20, Q	.25
South Lake	Boston	1¼	1¼	1¼	
Superior Copper	Boston	....	....	4 Apr. '17,	1.00
Superior & Boston	Boston	1⅛	1⅛	1⅛	
Tenn. C. & C. cfs.	New York	10⅛	9⅛	9⅛ May '18, I	1.00
Toulumne	Boston	*57	*50	*57 May '13,	.10
United Verde Ex.	Boston Curb	28	26	27½ May '21, Q	.25
Utah Consol.	Boston	4	4	4 Sept. '18,	.25
Utah Copper	New York	58⅛	55	55⅛ Mar. '21, Q	1.00
Utah Metal & T.	Boston	1⅛	1⅛	1⅛ Dec. '17,	.30
Victoria	Boston	*75	*75	*75	
Winona	Boston			*50	
Wolverine	Boston	11⅛	11	11	
NICKEL-COPPER					
Internat. Nickel	New York	16¼	15⅛	15⅜ Mar. '19,	.50
Internat. Nickel, pf.	New York	....	....	85 May '21, Q	1.50
LEAD					
National Lead	New York	79	77½	77½ Mar. '21, Q	1.50
National Lead, pfd.	New York	104⅜	102½	104⅜ Mar. '21, Q	1.75
St. Joseph Lead	New York	12⅜	12⅛	12⅛ Mar. '21, Q	.25
Stewart Mining	Boston Curb	....	....	*6 Dec. '15,	.05
ZINC					
Am. Z. L. & S.	New York	10	9¾	9¾ May '20,	1.00
Am. Z. L. & S, pfd.	New York	29	29	29 Nov. '20, Q	1.50
Butte C. & Z.	New York	5⅛	4⅞	5 June '18,	.50
Butte & Superior	New York	15⅛	14	14 Sept. '20,	1.25
Callahan Zn-Ld	New York	5⅛	5	5 Dec. '20, Q	.50
New Jersey Zn	N. Y. Curb	127	127	127 May '21, Q	2.00
Success	N. Y. Curb	*3	*2	*3 July '16,	.03
Yellow Pine	Los Angeles	....	....	*60 Sept. '20, Q	.03

* Cents per share. † Bid or asked. ‡ Quotations missing. Q, Quarterly. SA, Semi-annually. BM, Bi-monthly. K, Irregular. I, Initial. X, Includes extra.

Stock	Exch.	High	Low	Last	Last Div.
GOLD					
Alaska Gold	New York	⅛	⅛	⅛	
Alaska Juneau	New York	1⅛	1⅛	1⅛	
Carson Hill	N. Y. Curb.	14½	14	14¼	
Cresson Consol. G.	N. Y. Curb	1⅛	1⅛	1 1/16 June '20, Q	$0.10
Dome Extension	Toronto	....	....	*75	
Dome Mines	New York	20⅛	18⅛	19⅛ Apr. '21, Q	.25
Golden Cycle	Colo. Sprgs.	....	....	*73½ Dec. '20, Q	.02
Goldfield Consol.	N. Y. Curb			*8 Dec. '19,	.05
Hollinger Consol.	Toronto	7.33	7.23	7.32 Feb. '21, M	.05
Homestake Mining	New York	60	60	60 Sept. '19,	.50
Kirkland Lake	Toronto	*51	*47⅜	*49	
Lake Shore	Toronto	1.32	1.31	1.32 Jan. '21, K	.02
McIntyre-Porcupine	Toronto	2.00	1.97	1.99 Jan. '21, K	.05
Porcupine Crown	Toronto	*26½	*25½	*25½ July '17,	.03
Portland	Colo. Sprgs.	†*61	†*60	*62 Oct. '20, Q	.01
Reorgan. Booth	N. Y. Curb	*4	*3	*4 May '19,	.05
Silver Pick	N. Y. Curb	*5	*3½	*5	
Teck Hughes	Toronto	*16½	*16	*16½	
Tom Reed	Los Angeles	*80	*55	*80 Dec. '19,	.02
United Eastern	N. Y. Curb	2⅜	2 7/16	2⅜ Apr. '21, Q	.15
Vindicator Consol.	Colo. Sprgs.	*35	*35	*35 Jan. '20 Q	.01
West Dome Consol.	Toronto	*8½	*8½	*8½	
White Caps Mining	N. Y. Curb	*5	*3½	*4	
Yukon Gold	Boston Curb	....	....	*70 June '18,	.02½
SILVER					
Arizona Silver	Boston Curb	*25	*20	*25 Apr. '20, M	.03
Batopilas Mining	New York	1	1	1 Dec. '07, I	.12½
Beaver Consol.	Toronto	....	....	*34 May '20, K	.03
Coniagas	Toronto	1.70	1.70	1.70 May '21, Q	.12½
Crown Reserve	Toronto	....	....	*13 Jan. '17,	.05
Kerr Lake	Boston	3⅜	3⅛	3⅛ Apr. '21, Q	.12½
La Rose	Toronto	....	....	*20½ Apr. '18,	.02
McKinley-Dar.-Sav.	Toronto			*19 Oct. '20, Q	.03
Mining Corp. Can.	Toronto	1.08	1.08	1.08 Sept. '20, Q	.12½
Nipissing	N. Y. Curb	4⅛	4⅛	4⅛ Apr. '21, Q	.15
Ontario Silver	New York	5¼	4⅞	5 Jan. '19, Q	.50
Ophir Silver	N. Y. Curb	....	....	2 Jan. '12,	.10
Peterson Lake	Toronto	....	....	*6½ Jan. '17,	.01½
Temiskaming	Toronto	*18	*18	*18 Jan. '20, K	.04
Trethewey	Toronto	*17	*16½	*16¾ Jan. '19,	.05
GOLD AND SILVER					
Atlanta	N. Y. Curb	*1	*⅛	*1	
Barnes-King	Butte	‡....	....	1.10 Aug. '20, Q	.05
Boston & Montana	N. Y. Curb	*62	*59	*60	
Cashboy	N. Y. Curb	*6⅛	*5	*5½	
El Salvador	N. Y. Curb	1/16	¼	1/16	
Jim Butler	N. Y. Curb	*10	*8	*9 Aug. '18, SA	.07
Jumbo Extension	N. Y. Curb	*7	*6	*7 June '16,	.05
Louisiana Con.	N. Y. Curb	....	....	⅛	
MacNamara M.& M.	N. Y. Curb	*24	*18	*18 May '10,	.02½
N. Y. Hond. Rosar.	Open Mar.	†10½	†9	.... Jan. '21, Q	.30
Tonopah-Belmont	N. Y. Curb	1 7/16	1 7/16	1⅜ Apr. '21, Q	.05
Tonopah-Divide	N. Y. Curb	1¼	1⅛	1¼	
Tonopah-Extension	N. Y. Curb	1 7/16	1 7/16	1⅜ Apr. '21, Q	.05
Tonopah Mining	N. Y. Curb	1 7/16	1 7/16	1⅜ Apr. '21, SA	.05
West End Consol.	N. Y. Curb	1 7/16	1⅛	1 Dec. '19, SA	.05
SILVER-LEAD					
Caledonia	N.Y. Curb	*11	*10	*11 Jan. '21, M	.01
Cardiff M. & M.	Salt Lake	1.15	1.12½	1.12½ Dec. '20,	.15
Chief Consolidated	Boston Curb	2½	2½	2½ May '21, Q	.05
Consol. M. & S.	Montreal	17	16½	16½ Oct. '20, Q	.62½
Daly Mining	Salt Lake	....	....	2.50 July '20, Q	.10
Daly-West	Boston	....	....	3 Dec. '20, Q	.25
Eagle & Blue Bell	Boston Curb	....	....	2½ Apr. '21, K	.05
Electric Point	Spokane	*7⅛	*7	*7⅛ May '20, SA	.03
Federal M. & S.	New York	8½	8½	8½ Jan. '09,	1.50
Federal M. & S., pfd.	New York	27½	26½	27½ Mar. '21, Q	1.00
Florence Silver	Spokane	*12½	*12½	*12½ Apr. '19,	.01½
Grand Central	Salt Lake	....	....	*07½ June '20, K	.03
Hecla Mining	N. Y. Curb	4½	4	4½ Mar. '21, Q	.15
Iron Blossom	N. Y. Curb	....	....	*20 Apr. '20, Q	.02½
Judge M. & S.	Salt Lake			3.00 Sept. '20, Q	.12½
Marsh Mines	N. Y. Curb	*8	*6½	*7½	
Prince Consol.	N. Y. Curb	1/16	¼	1/16 Nov. '17,	.02½
Rambler-Cariboo	Spokane	*5	*5	*5 Feb. '19,	.01
Rex Consol.	N. Y. Curb	*12	*10	*11	
South Hecla	Salt Lake	....	....	*65 Sept. '19, K	.15
Standard Silver-Ld.	N. Y. Curb	1/16	⅛	1/16 Oct. '17,	.05
Tamarack-Custer	Spokane	1.80	1.70	1.80 Jan. '21, K	.04
Tintic Standard	Salt Lake	2.50	2.42½	2.42½ June '20, Q	.10
Utah Apex	Boston	2⅜	2⅛	2⅛ Nov. '20, K	.25
Wilbert Mining	N. Y. Curb	*4	*3	*4 Nov. '17,	.01
QUICKSILVER					
New Idria	Boston	....	....	*50 Jan. '19,	.25
VANADIUM					
Vanadium Corp.	New York	35	31½	31½ Jan. '21, Q	1.00
ASBESTOS					
Asbestos Corp.	Montreal	60½	58	58 Apr. '21, Q	1.50
Asbestos Corp., pfd.	Montreal	83	80	80 Apr. '21, Q	1.75
MINING, SMELTING AND REFINING					
Amer. Sm. & Ref.	New York	43½	41½	41⅝ Mar. '21, Q	1.00
Amer. Sm. & Ref. pf.	New York	78⅛	77⅛	77⅛ Mar. '21, Q	1.75
Am. Sm. pf. A	New York	72	71	71 Apr. '21, Q	1.50
U. S. Sm. R. & M.	New York	35⅛	34	34 Jan. '21, Q	.50
U.S.Sm.R.& M. pf.	Boston	41⅛	40½	41⅛ Apr. '21, Q	.87½